DELAWARE COUNTY REGIONAL WATER QUALITY CONTROL AUTHORITY
P.O. Box 999 • Chester, PA 19016-0999

January 26, 2017

FED EX – NEXT DAY

Chief, Environmental Enforcement Section
Environment and Natural Resources Division
U.S. Department of Justice
601 D Street NW
Washington, DC 20004
Re: DOJ No. 90-5-1-1-10972

Philip Yeany
Office of Regional Counsel (3RC20)
U.S. EPA, Region 3
1650 Arch Street
Philadelphia, PA 19103-2029

Chief
NPDES Enforcement Branch (3WP42)
Water Protection Division
U.S. EPA, Region 3
1650 Arch Street
Philadelphia, PA 19103-2029

Program Manager – Clean Water Program
PA DEP
Southeast Regional Office
2 East Main Street
Norristown, PA 19401

RE: Civil Action Number Case 2:15-cv-04652-RB
& DOJ Case Number 90-5-1-1-10972
Rainfall and Flow Monitoring Quarterly Report No. 3
Period of October 1, 2016 – December 31, 2016

Dear Sir/Madam:

By this letter, the Delaware County Regional Water Quality Control Authority is enclosing a copy of the above mentioned report in accordance with the requirements of the Consent Decree.

If there are any questions, please contact me. Thank you.

Sincerely,

Michael J. DiSantis
Director of Operations & Maintenance

MJD:bab
enclosure

ADMINISTRATION
☐610-876-5523
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cc: via email
Margaret Hill, Blank Rome
Marlene Finizio, Greeley and Hansen
Michael Hope, Greeley and Hansen
Ed Bothwell, DELCORA
Charles Hurst, DELCORA
Michael DiSantis, DELCORA
John Pileggi, DELCORA
Robert Willert, DELCORA
File – Consent Order – LTCP CSO

Delaware County Regional Water Quality Control Authority
CSO Long Term Control Plan Update

# Rainfall and Flow Monitoring Quarterly Report No. 3

## (October 01, 2016 to December 31, 2016)

## *Final*

January 2017

GREELEY AND HANSEN

# REPORT SIGNATURE COVER SHEET

*Signature of this cover signifies agreement with the content of the DELCORA Rainfall and Flow Monitoring Quarterly Report No. 3.*

I certify under penalty of law that the document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

| | | |
|---|---|---|
| **DELCORA MANAGEMENT** | | |
| **Executive Director** | *Signature* | 1/25/17 *Date* |
| **DELCORA ENGINEERING** | | |
| **Director of Engineering** | *Signature* | 1/25/17 *Date* |
| **DELCORA OPERATIONS AND MAINTENANCE** | | |
| **Director of Operation and Maintenance** | *Signature* | 1/25/17 *Date* |

# REVISION CONTROL

| REV. NO. | DATE ISSUED | PREPARED BY | DESCRIPTION OF CHANGES |
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## Section 1 Introduction

The Delaware County Regional Water Quality Control Authority (DELCORA) entered into a Consent Decree (CD) with the United States Government in August 2015. The purpose of the Consent Decree is to establish a schedule for implementation of Long Term Control Plan Update (LTCPU) to achieve full compliance with the Clean Water Act and the regulations and Clean Streams Law and regulations. The lodging of this Consent Decree was entered by the court on August 17, 2015, it was signed and filed on November 10, 2015 by the United States District Court for the Eastern District of Pennsylvania.

According to the Consent Decree, DELCORA's Hydrologic and Hydraulic Model (H&H Model) must be updated to meet the requirements in Section V.A.14 of the Consent Decree. A detailed plan to update, calibrate and validate the H&H model has been submitted and approved by the USEPA on March 1, 2016. Additional rainfall and flow monitoring is required to calibrate and validate the H&H model. Requirements of rainfall and flow monitoring are detailed in the Consent Decree Section V.A.14.d and e, which is included in the following:

> "*d.* *Rainfall and flow monitoring shall be carried out in accordance with current good industry practice for a period of at least twelve* ***(12) months****, in accordance with the schedule included in the approved plan. Rainfall data shall be obtained at a minimum effective density of 1 gauge/virtual radar-based gauge per square kilometer, for the entire Model Area. Flow monitoring shall be carried out using sufficient monitors to allow the accurate characterization of dry and wet weather flows from the entire Model Area, and the response of each CSO to wet weather flows.*
>
> *e.* *For all rainfall and flow monitoring carried out in support of efforts to update and calibrate the H&H Model, DELCORA shall prepare and submit to Plaintiffs for review and comment in accordance with the requirements of Section VI (Review and Approval of Submittals) quarterly technical memoranda documenting the results and quality of the rainfall and flow monitoring data."*

In summary, rainfall and flow monitoring shall be conducted for at least 12 months, and quarterly technical memoranda shall be submitted to Plaintiffs for review.

To satisfy the above mentioned rainfall and flow monitoring requirements, and in accordance with the submitted DELCORA H&H Model Update and Calibration Plan, DELCORA has installed 5 new rain gauges and 39 new flow meters in its sewer collection system. Starting from March 18, 2016, most of the newly installed rain gauges and flow meters were in service and began generating data.

**This report is a summary of the Rainfall and Flow Monitoring during October 1, 2016 to December 31, 2016.**

# Section 2 Rainfall Monitoring

## 2.1 Rainfall Monitoring Locations

The site locations of the four existing and five newly installed rain gauges are shown in **Figure 1**. These rain gauges provide an effective spatial coverage of the entire WRTP's service area.

The four (4) existing rainfall gauges are in Delaware County that record precipitation in 15-minute increments. The gauges are located at the following DELCORA owned facilities:

- Western Regional Treatment Plant (WRTP, will be used for model calibration)
- Central Delaware County Pump Station (CDPS, will be used for model calibration)
- Muckinipates Pump Station (MPS, will be used for model calibration)
- Darby Creek Pump Station (DCPS, will NOT be used for model calibration)

The five (5) newly installed rain gauges are listed in **Table 1** with detail information of rain gauge location, service starting date, and data recording interval.

**Table 1: Newly Installed Rain Gauges**

| | Rain Gauge ID | Location | Service Start Date | Data Interval |
|---|---|---|---|---|
| 1 | RG_Rose Valley | 18 N. Longpoint Lane, Media, PA | 3/05/16 | 5-minute |
| 2 | RG_Chester-PS | 55 East 2nd Street, Chester, PA | 3/05/16 | 5-minute |
| 3 | RG_NCPS | 1628 Naamans Creek Rd., Marcus Hook, PA | 3/05/16 | 5-minute |
| 4 | RG_Springfield | 217 Saxer Avenue, Springfield, PA | 4/03/16 | 5-minute |
| 5 | RG_UCT | 1671 N. Upper Providence Road, Media, PA | 4/16/16 | 5-minute |

## 2.2 Rain Gauge Calibration/Verification Procedure

Rain Gauge calibrations were performed during the rain gauge installation. Additional calibrations will be performed to the manufacturer's specifications on a bi-annual basis or as needed if irregular data is observed. Rain gauges are routinely checked for debris, and cleared after snow/ice storms.

Each "tip" of the rain gauge bucket should correspond with 0.01" of rain. To ensure the modem is reading the tipping bucket pulse accurately, the tech will tip the bucket 10 times in rapid succession. The tech should see that 0.1" of rain is recorded.

## 2.3 Rainfall Event Summary

Rainfall events were analyzed for each individual rain gauge based on the inter-event time of 12 hours. In total there were 17 rainfall events during reporting period. **Table 2** lists all 13 rainfall events with total precipitation greater than 0.1 inch.

## Figure 1: Rain Gauge Locations

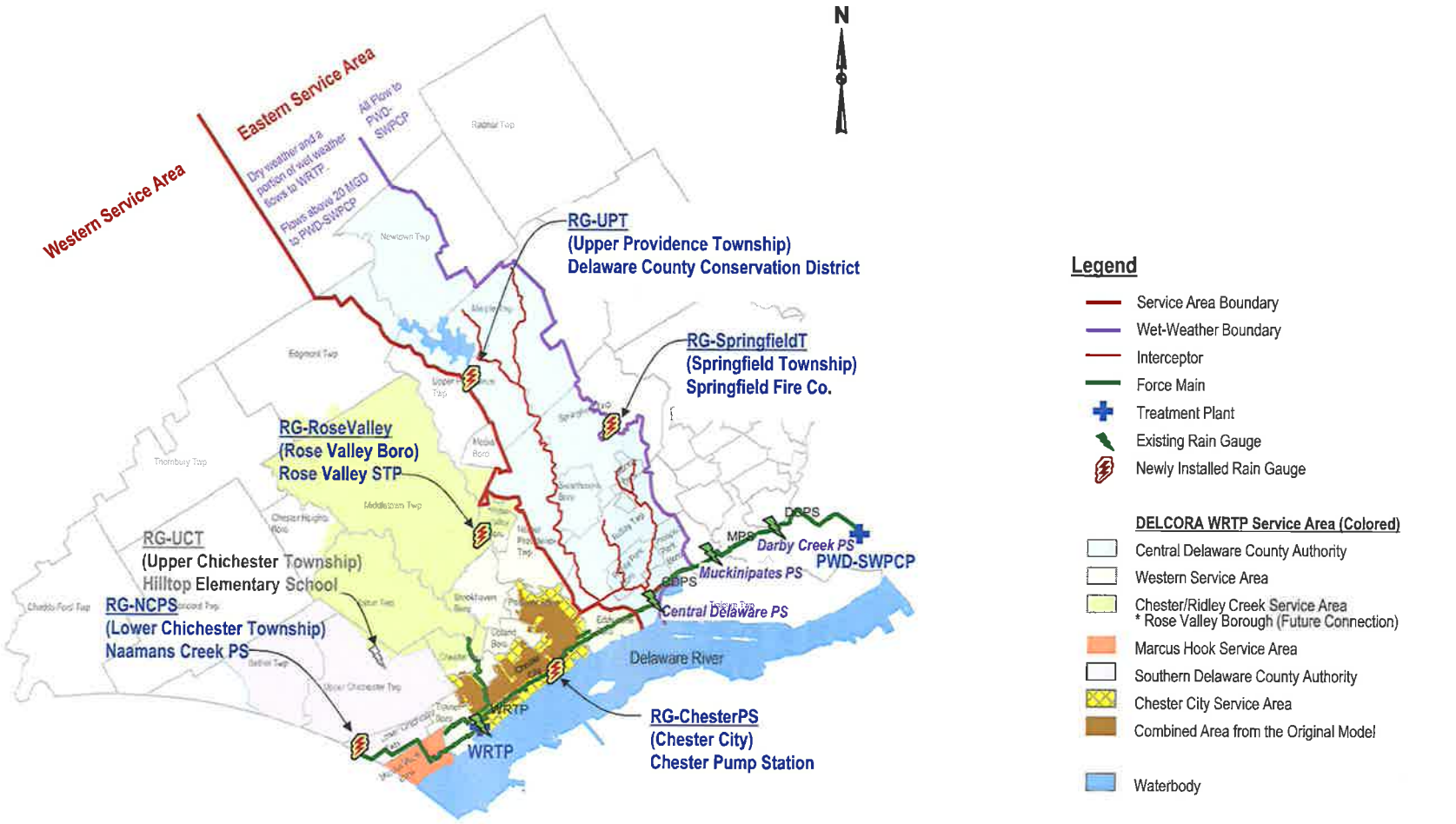


**Figure 2** shows rainfall amounts at each rain gauge in each month for October, November and December. It is obvious that rainfall in the area has significant spatial and temporal variance. As an example, during this reporting period, the rain gauge at the Chester Pump Station (Chester PS) recorded a total rainfall of 6.65 inches while the gauge at the Upper Providence Township (UPT) recorded 8.52 inches. **Figure 3** shows the 1-hour rainfall profile for all of the 5 rain gauges.

**Table 2: Rainfall Event Summary, 10/1/16 - 12/31/16**

| | Rain Event Starting Time | Rose Valley | Chester-PS | NCPS | Springfield | UPT |
|---|---|---|---|---|---|---|
| 1 | 10/8/2016 13:25 | 0.91 | 1 | 1.1 | 0.82 | 1.05 |
| 2 | 10/21/2016 20:55 | 0.24 | 0.2 | 0.2 | 0.24 | 0.36 |
| 3 | 10/27/2016 8:30 | 0.45 | 0.54 | 0.71 | 0.32 | 0.43 |
| 4 | 10/30/2016 17:45 | 0.25 | 0.23 | 0.21 | 0.37 | 0.65 |
| 5 | 11/9/2016 7:25 | 0.26 | 0.23 | 0.31 | 0.29 | 0.33 |
| 6 | 11/19/2016 20:25 | 0.08 | 0.03 | 0.17 | 0.06 | 0.14 |
| 7 | 11/29/2016 5:30 | 1.74 | 1.84 | 2.13 | 2.39 | 2.37 |
| 8 | 12/5/2016 0:25 | 0.14 | 0.12 | 0.12 | 0.14 | 0.14 |
| 9 | 12/6/2016 13:35 | 0.8 | 0.69 | 0.22 | 0.92 | 0.99 |
| 10 | 12/12/2016 1:05 | 0.57 | 0.39 | 0.46 | 0.47 | 0.68 |
| 11 | 12/17/2016 7:20 | 0.82 | 0.79 | 0.89 | 0.85 | 0.61 |
| 12 | 12/24/2016 4:35 | 0.44 | 0.36 | 0.53 | 0.43 | 0.51 |
| 13 | 12/29/2016 6:30 | 0.31 | 0.23 | 0.28 | 0.25 | 0.26 |
| | Subtotal (10/1/16-12/31/16) | 7.01 | 6.65 | 7.33 | 7.55 | 8.52 |

**Figure 2: Rainfall Event Summary, 10/1/16 - 12/31/16**

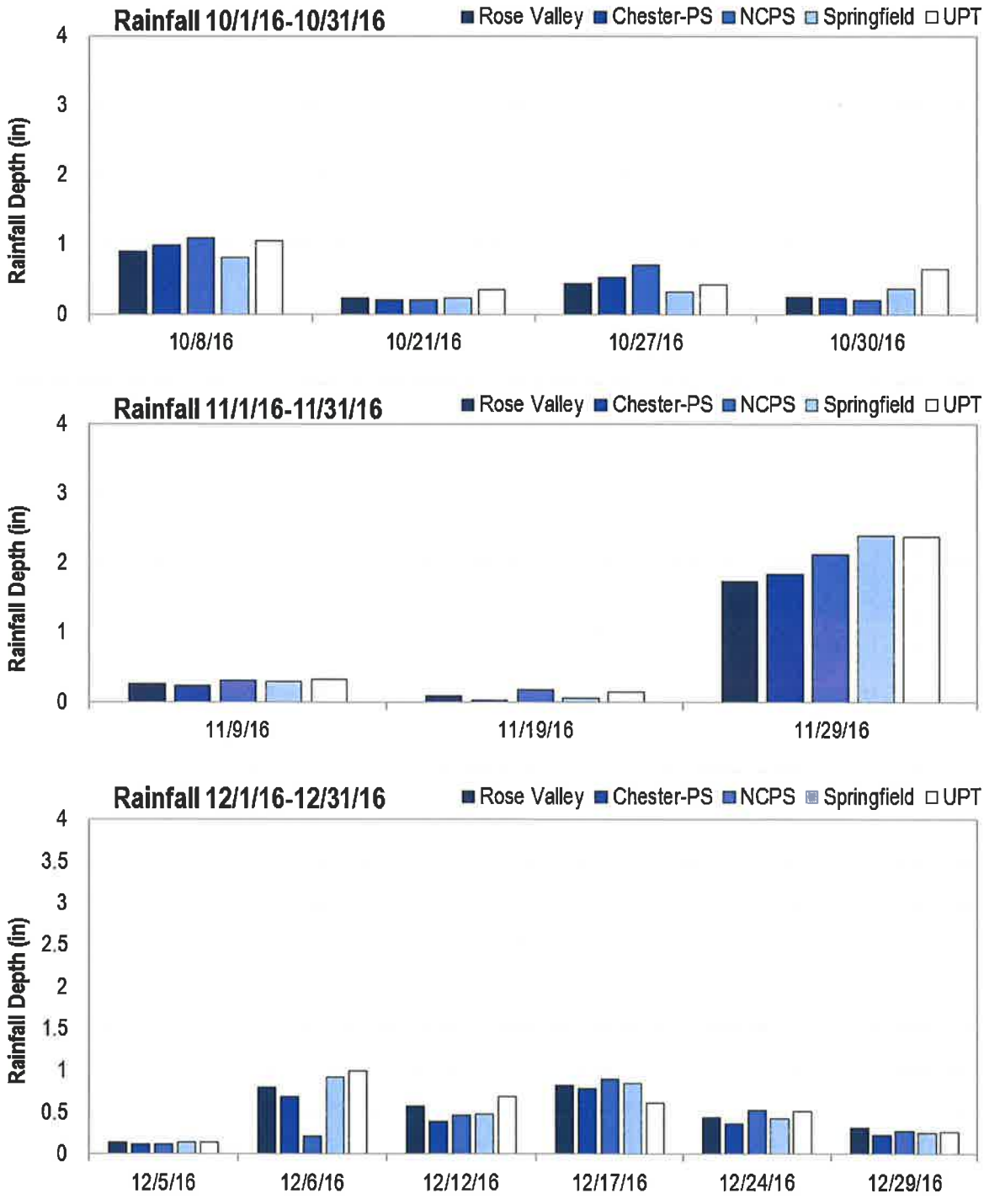
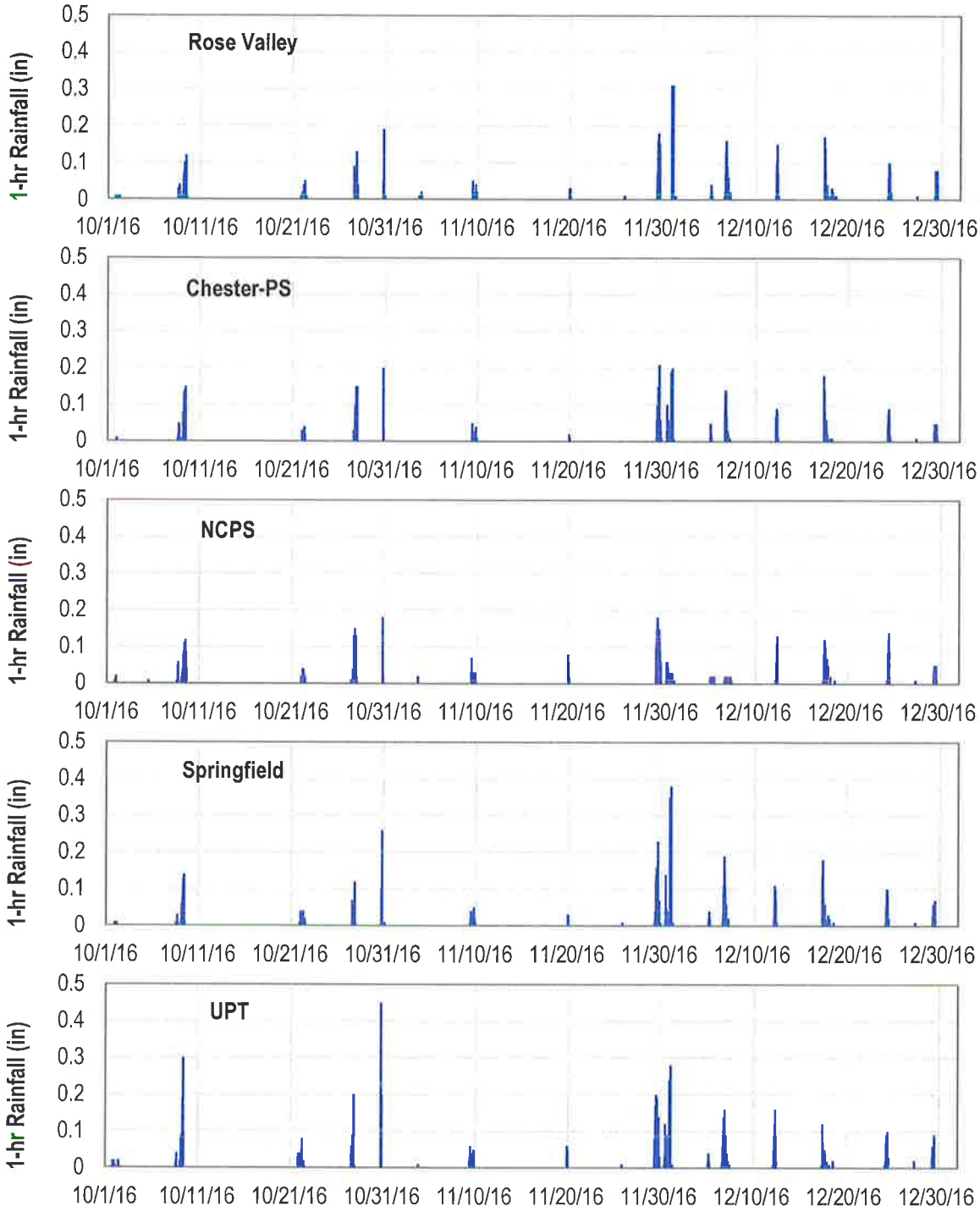


**Figure 3: Hourly Rainfall Profile**



### 2.3.1 Rainfall Return Frequency

Rainfall return frequency was analyzed for rain gauges RG_NCPS and RG_UPT because they usually record greater rainfall amounts than the others. The frequency analysis was also performed for RG_ChesterPS because it is located in the combined area.

**Figure 4** shows Duration-Depth-Frequency (DDF) plot for RG_NCPS. Two storms were recorded with total precipitation volumes greater than 1 inch. Both events (10/8/17 and 11/29/17) are less than 1-year events.

**Figure 4: Duration-Depth-Frequency (DDF) Plot, RG_NCPS**

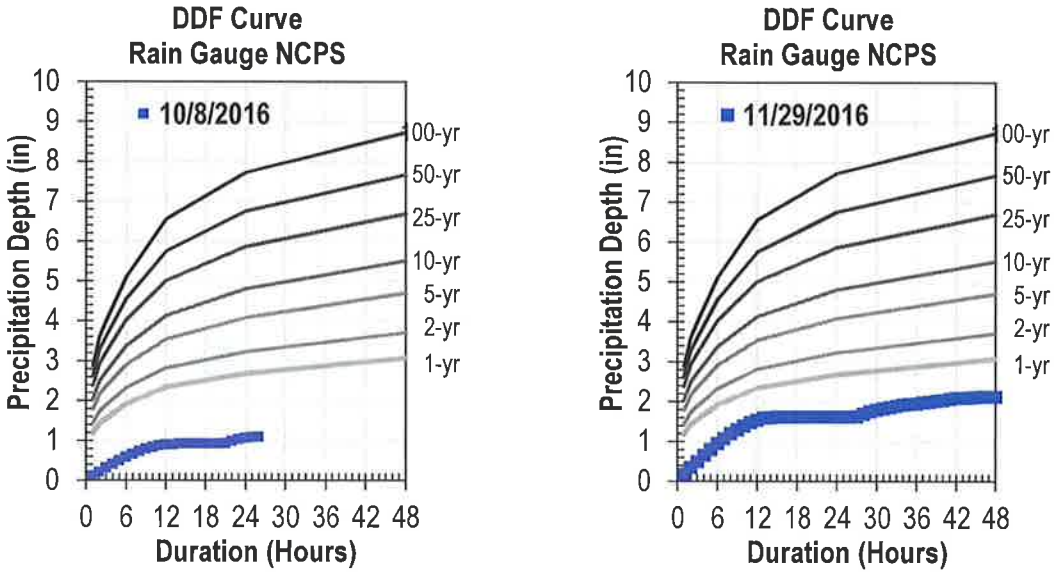



**Figure 5** shows Duration-Depth-Frequency (DDF) plot for RG_UPT. Two storms were recorded with total precipitation volumes greater than 1 inch. Both events (10/8/17 and 11/29/17) are less than 1-year events.

**Figure 5: Duration-Depth-Frequency (DDF) Plot, RG_UPT**

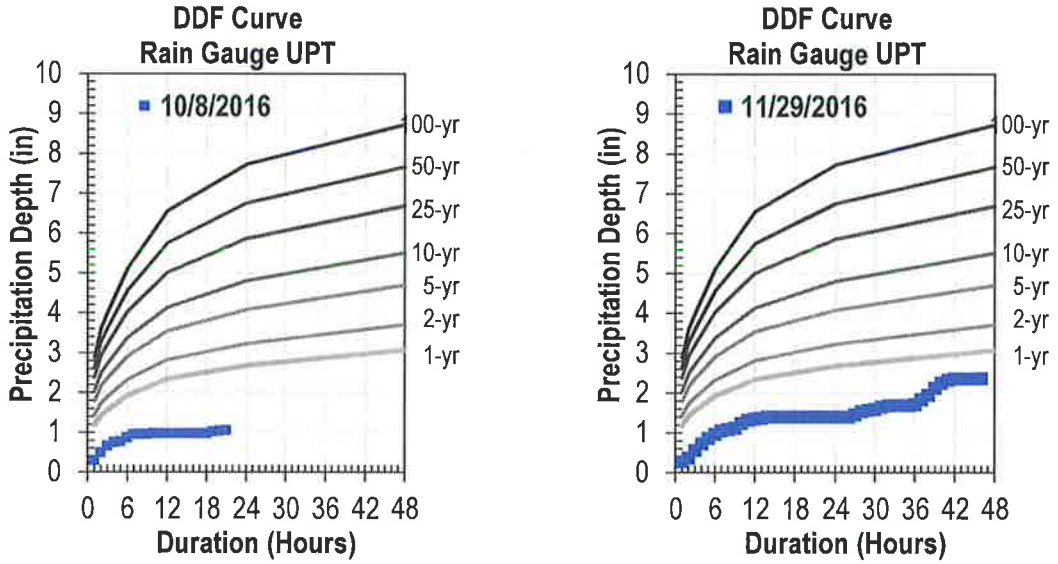
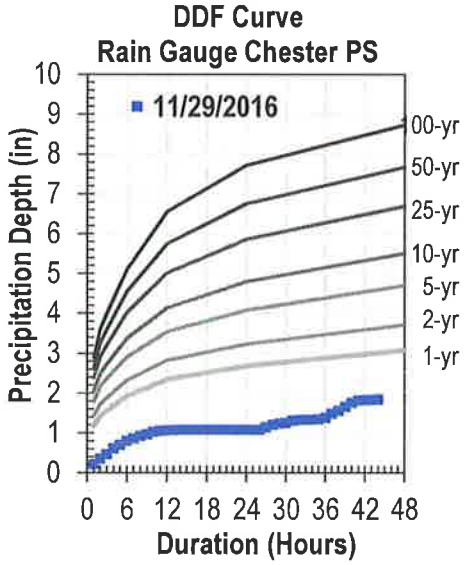



**Figure 6** shows Duration-Depth-Frequency (DDF) plot for RG_ChesterPS. Only one storm (11/29/17) was recorded with a total precipitation volume greater than 1 inch. It is less than a 1-year event.

**Figure 6: Duration-Depth-Frequency (DDF) Plot, RG_Chester PS**



# Section 3 Flow Meter Monitoring

## 3.1 Flow Monitoring Program

The site locations of the existing and newly installed flow meters are shown in **Figure 7**. **Figure 8** shows the newly installed flow meters on a larger scale, mostly in the combined area. These new meters were installed to investigate surface runoff from the combined area and CSO discharges, rainfall-derived inflow and infiltration (RDII) from the separated area, and system response to the wet weather conditions. The schematic of the newly installed flow meters is included in **Figure 9**.

The newly installed flow meter locations are categorized into the following four types:

- Category 1: Located on the influent pipe to CSO regulators, this is to measure the influent flow to CSO regulators and for combined area runoff calibration. Sixteen (16) meters were installed for this category.
- Category 2: Located on the effluent pipe and overflow pipe of CSO regulators, this is to measure the CSO overflows and calibrate CSO regulator parameters. Twelve (12) meters were installed for this category. They are on the effluent and overflow pipe of CSOs 02, 03, 05, 08, 14, & 19.
- Category 3: Located on the side-line from the combined areas (flows from the combined area tie into interceptor instead of CSO regulator). This is to measure flows from the combined area and to calibrate combined area runoff parameters. Two (2) meters were installed for this category.
- Category 4: Located upstream of the combined area, this is to measure flows from the upstream separated area for RDII characterization. Three (3) meters were installed for this category.
- Category 5: Located in the main interceptors to measure level and flows in the major interceptors. Five (5) meters were installed for this category.

One meter was proposed at manhole MH3029 to measure flow from the separated area upstream of the combined area (CSO#018). The site was severely surcharged during field investigation. Meanwhile it was found that at manhole MH3002 (four manholes upstream of MH3029, approximately 800 feet upstream) another CSL flow meter (Ridley Creek MH-28) was already installed for DELCORA. It was determined that instead of installing a new flow meter around the site, the team will use the existing meter Ridley Creek MH-28 for this flow monitoring program.

In total, 39 flow meters are included in this monitoring program. Details of the installed flow meters are included in **Table 3**.

## 3.2 Flow Meters Field Calibration/Verification Procedures

As part of the operation of flow meters, verifications of meter accuracy are performed on a regular basis. Calibrations are performed at a minimum every eight weeks, or more as needed.

The procedure used for performing meter calibrations is outlined below. This procedure only defines the required result. Any specific equipment function issues should be referred to the equipment manual or the manufacturer's technical support department.

## Table 3: Details of the Newly Installed Flow Meters

| Meter ID | GIS ID | Location | Pipe Size (in) | Material | Evidence of Surcharge | Category |
|---|---|---|---|---|---|---|
| CSO 02 | 3462 | DS | 36 | Brick | Yes | 2 |
| CSO 03 | 2726 | DS | 38 | Brick | Yes | 2 |
| CSO 05 | 2634 | DS | 48 | Concrete | Yes | 2 |
| CSO 08 | 3463 | DS | 60 | Concrete | Yes | 2 |
| CSO 14 | 3481 | DS | 45"x53" | Brick | Yes | 2 |
| CSO 19 | 690 | DS | 42"x43" | Concrete | Yes | 2 |
| Eff-02 | 3460 | US | 8 | Clay | Yes | 2 |
| Eff-03 | 3454 | DS | 14.25 | Concrete | Yes | 2 |
| Eff-05 | 2635 | DS | 12 | Concrete | Yes | 2 |
| Eff-08 | 2246 | DS | 18.2 | PVC | Yes | 2 |
| Eff-14 | 3482 | DS | 18 | Concrete | Yes | 2 |
| Eff-19 | *** | DS | 36 | Concrete | Yes | 2 |
| In-03 | 2721 | US | 36 | Brick | Yes | 1 |
| In-05 | 2634 | US | 28 | Brick | Yes | 1 |
| In-08 | 3463 | US | 60 | Concrete | Yes | 1 |
| In-09 | 1987 | US | 48 | Cast Iron | Yes | 1 |
| In-10 | 1670 | US | 36 | Brick | Yes | 1 |
| In-11 | 1770 | US | 49 | Cast Iron | Yes | 1 |
| In-13 | 3479 | US | 48 | Concrete | Yes | 1 |
| In-14 | 3481 | DS | 43"x47" | Brick | Yes | 1 |
| In-16 | 752 | US | 60 | Concrete | No | 1 |
| In-17 | 691 | US | 36 | Brick | Yes | 1 |
| In-18 | 3033 | US | 66"x43" | Concrete | Yes | 1 |
| In-19-1 | 625 | DS | 49"x47.5" | Clay | No | 1 |
| In-19-2 | 688 | US | 42" | Concrete | Yes | 1 |
| In-2 | 2751 | DS | 36 | Corrugated PVC | No | 1 |
| In-25 | 3502 | US | 36 | Concrete | Yes | 1 |
| In-26 | 1192 | US | 36 | Brick | No | 1 |
| INT- 2nd St | 1548 | DS | 40 | Concrete | No | 5 |
| INT-DRI | 2743 | US | 24 | Clay | Yes | 5 |
| INT-Ridley 2 | 1487 | US | 44 | Concrete | Yes | 5 |
| INT-Ridley 3 | 1509 | US | 48 | Concrete | Yes | 5 |
| INT-WestEnd | 2755 | US | 53 | Concrete | No | 5 |
| Sep-1 | 2135 | US | 15 | Clay | Yes | 4 |
| Sep-2 | 2134 | DS | 12 | Clay | No | 4 |
| Sep-3 | 798 | US | 24 | Clay | No | 4 |
| Sep-4 (Existing, Ridley Creek MH-28) | | | 30 | Concrete | No | 4 |
| Side-1 | 1571 | US | 36 | Concrete | No | 3 |
| Side-2 | 2135 | US | 8 | Clay | Yes | 3 |

## Figure 7: Existing and Newly Installed Flow Meter Locations

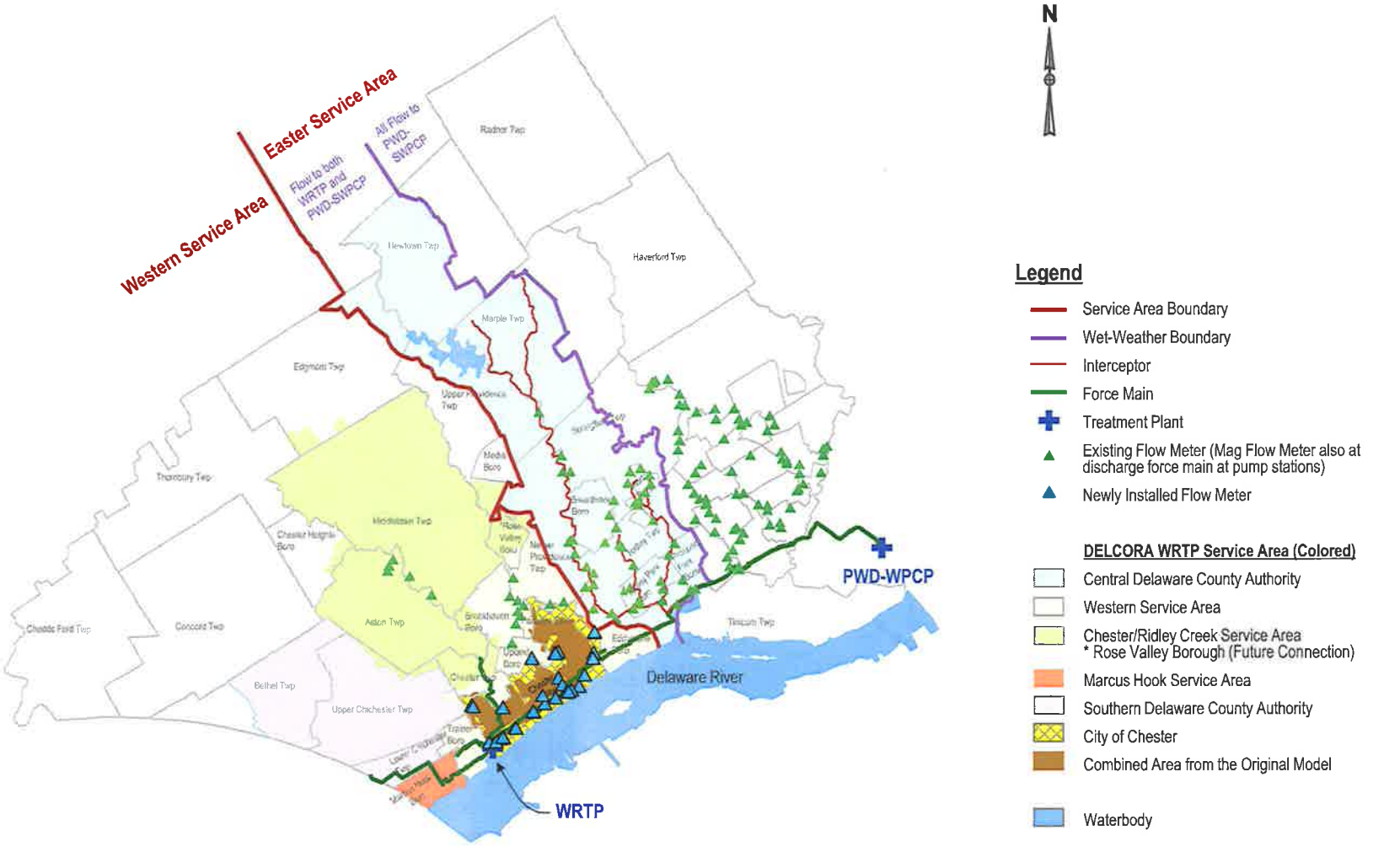


**Figure 8: Newly Installed Flow Meter Locations**

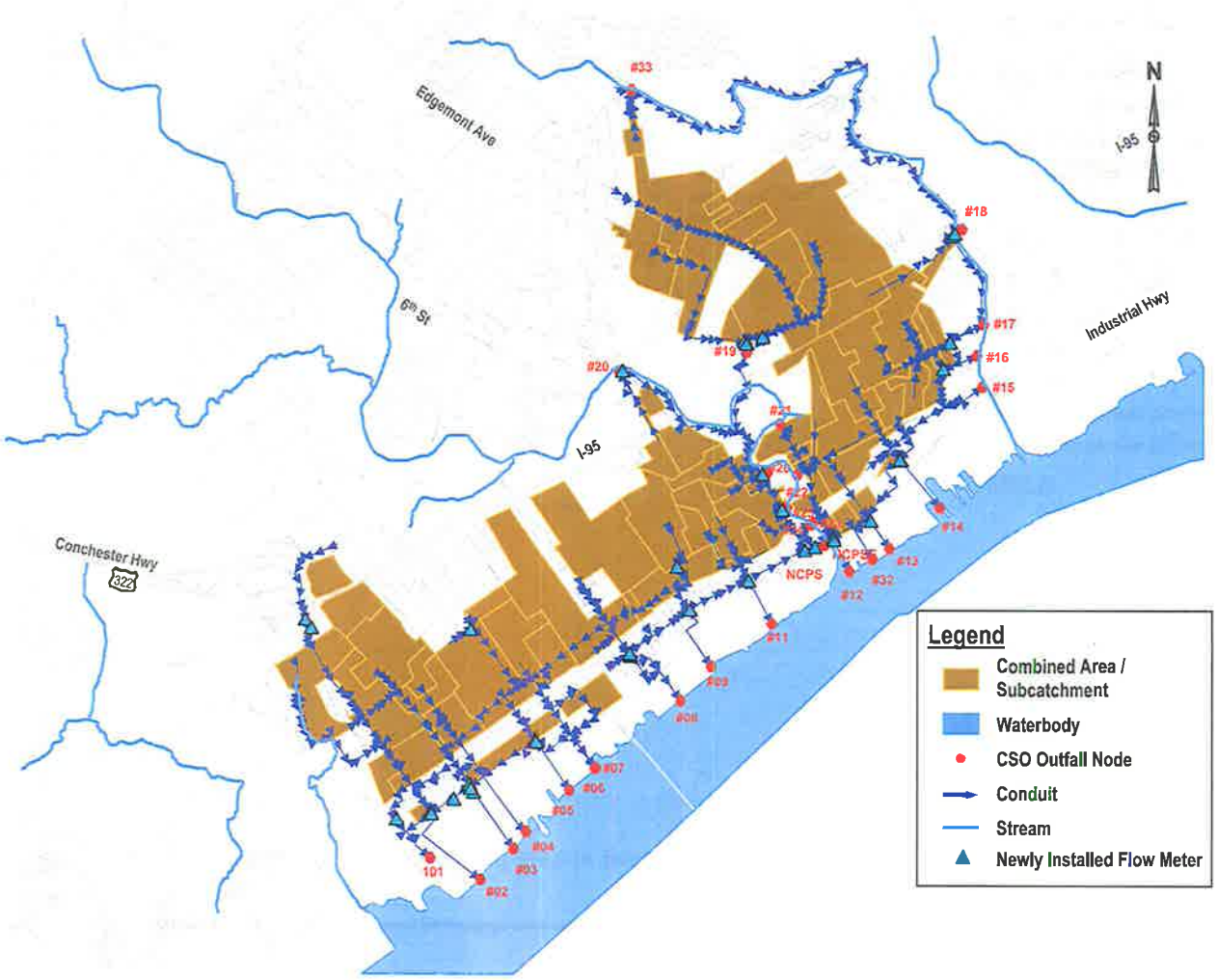
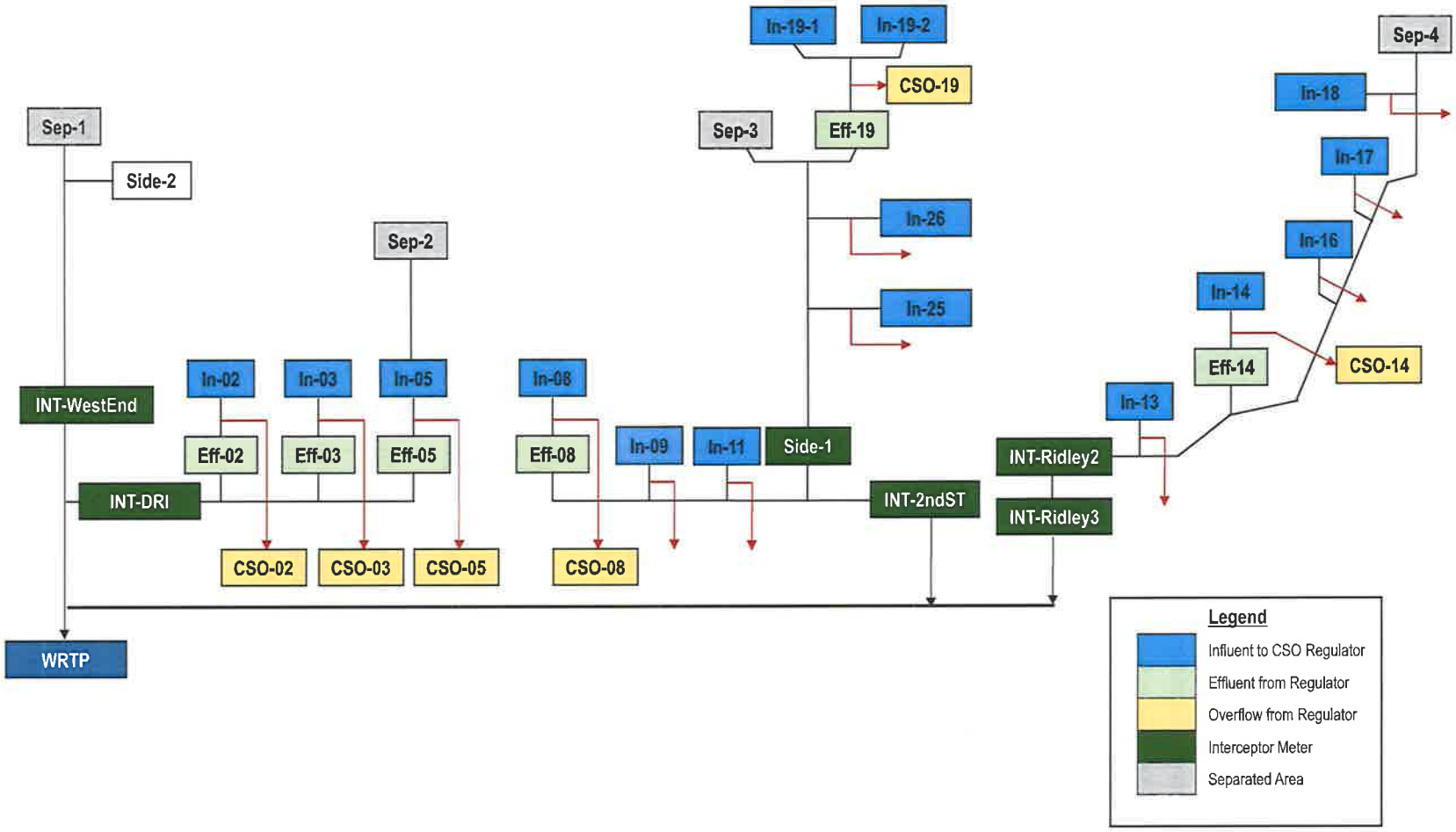


**Figure 9: Flow Monitoring Schematic**



**Manually Downloaded Meters**
This method is used for any meter that cannot be interrogated remotely by the data analyst. Field technicians use the *Daily Field Download Sheet* for recording the calibration results.

- Record the date.
- Record the field time, which is the local time.
- Record the meter time.
- Record the instantaneous depth reading from the meter.
- Measure the peak velocity.
- Record the instantaneous average or peak, whichever is applicable.
- Note any service performed at the site, included sensor scrubbing.

The resulting meter readings should be within 0.25" for depth and within 10% for peak-to-peak or average-to-average for velocity. Should readings be outside these guidelines, troubleshooting is conducted per the manufacturer guidelines. If this does not resolve the discrepancy, the data manager is notified.

**Remote Connection Meters**
This method is used for any meter that can be interrogated remotely. The data analyst uses the *Daily Field Download Sheet* for single depth and velocity meters and the *Multi- Sensor Calibration Sheet* for meter types that record multiple depth and/or velocity readings.

- Fill all site visit information fields on form.
- Have the field tech measure the depth of flow and record with time.
- Record the time and instantaneous depth reading from the meter or the depth sensor, whichever is applicable. All available depth sensors should be activated and compared to the field measurement.
- Have the field tech measure the peak the velocity or have them perform a velocity profile if the depth is sufficient then record with time.
- Record the time and instantaneous velocity reading from the meter or the velocity sensor, whichever is applicable. All available velocity sensors should be activated and compared to the field measurement.
- Note any service performed at the site, included sensor scrubbing.

The resulting meter readings should be within 0.25" for depth and within 10% for peak-to-peak or average-to-average for velocity. Should readings be outside these guidelines, troubleshooting is conducted per the manufacturer guidelines. If this does not resolve the discrepancy, the data manager is notified.

**Special Cases**

- Blind Verifications: A blind verification occurs when a field technician's only role is to measure the depth and velocity of the flow and report the values to the data analyst. In these cases, the crew is "blind" to what the meter is reading. The data analyst will then compare the readings to current/recent data or live readings. Should the blind verification be out of tolerance, the analyst can direct the crew to perform additional blind verifications or perform a conventional verification and/or troubleshoot as necessary.

- Installations/Removals: When installing or removing meters, the above calibration method should be used for three consecutive verifications, performed at 5 minute intervals.
- Third Party Audit: When performing a calibration at a meter that is not maintained by CSL and where CSL is to verify the meter function, the CSL Audit report should be used.

## 3.3 Flow Monitoring Data Summary

Flow, level and velocity data are received for each flow monitoring site at 5-minute intervals (Sep-4 has 15-min interval data). Metering data is analyzed for dry weather flows (DWF), hourly peak flows, and hourly peaking factors for each monitoring site. A "dry weather" condition was defined as a period with no precipitation that begins three days after the last wet weather event and lasts until the beginning of the next precipitation event.

**Table 4** shows dry weather flow (DWF), hourly peak flow, hourly peaking factor and flow condition observations.

The dry weather flows are also shown in the schematic in **Figure 10**. Generally the downstream dry weather flow is greater than the upstream locations for all of the meters. For meters immediately upstream and downstream of CSO regulators, the upstream and downstream dry weather flows should be similar. **Figure 11** shows the influent and effluent from CSO#08 as an example to indicate that the dry weather of the two are similar.

The hourly peaking factor in the combined area is in the range of 7 to 99 and average at 27. The hourly peaking factor for the interceptor is between 2.8 and 5.2 with an average of 3.9. The hourly peaking factor is between 2.7 and 3.6 for the separated area, with an average of 3.1.

A detailed hydrograph and scattergraph for each flow monitoring site is shown in **Figure 12** to **Figure 50**, each includes:

- The flow hydrographs show hourly flow and rainfall profile. Hourly Rainfall data is included for the convenience of reviewing flow response to the wet weather conditions. Hourly flow and rainfall were calculated from the 5-min interval.
- The scattergraphs (based on 5-min data, excepting 15-min data for Sep-4) are essentially a plotting of flow rate versus depth. This plotting helps to understand the flow patterns and conditions on the individual monitored sewer pipes.
- For CSOs 02, 03, 05, 08, 14, & 19, flows including influent, effluent and overflows were plotted in the same plot.

## Table 4: Flow Monitoring Summary

| Meter ID | Hourly Peak (MGD)DWF | DWF (MGD) | Hourly Peaking Factor | Comments |
|---|---|---|---|---|
| In-02 | 6.25 | 0.29 | 21.7 | Free flow most of the time |
| Eff-02 | 1.19 | 0.26 | 4.5 | Surcharged under common conditions |
| CSO-02 | 5.01 | 0.04 | | Free flow most of the time |
| In-03 | 9.46 | 0.28 | 33.6 | Free flow most of the time |
| Eff-03 | 1.52 | 0.24 | 6.2 | Surcharged under large storms |
| CSO-03 | 8.85 | 0.03 | | Free flow most of the time |
| In-05 | 22.65 | 0.86 | 26.4 | Backwater observed |
| Eff-05 | 2.30 | 0.75 | 3.1 | Severely surcharged under common conditions |
| CSO-05 | 18.83 | 0.10 | | Free flow most of the time, backwater observed |
| In-08 | 21.99 | 0.80 | 27.5 | Free flow most of the time |
| Eff-08 | 5.21 | 0.69 | 7.5 | Free flow most of the time |
| CSO-08 | 22.36 | 0.11 | | Free flow most of the time |
| In-09 | 7.09 | 0.13 | 53.8 | Free flow most of the time |
| In-10 | 4.55 | 0.18 | 25.6 | Free flow most of the time |
| In-11 | 9.04 | 0.22 | 41.2 | Free flow most of the time |
| In-13 | 28.52 | 0.34 | 82.8 | Free flow most of the time, backwater during large storms |
| In-14 | 14.44 | 0.43 | 34.0 | Backwater observed |
| Eff-14 | 4.22 | 0.38 | 11.0 | Free flow mostly, backwater and surcharge during large storms |
| CSO-14 | 11.33 | 0.03 | | Free flow most of the time |
| In-16 | 12.95 | 0.33 | 38.7 | Free flow most of the time, backwater during large storms |
| In-17 | 6.90 | 0.17 | 41.2 | Backwater observed |
| In-18 | 10.05 | 0.16 | 61.7 | Free flow most of the time |
| In-19-1 | 6.24 | 0.69 | 9.1 | Free flow most of the time |
| In-19-2 | 11.62 | 0.57 | 20.2 | Free flow most of the time |
| Eff-19 | 4.02 | 1.27 | 3.2 | Free flow most of the time |
| CSO-19 | 10.72 | 0.07 | | Free flow most of the time |
| In-25 | 12.55 | 0.15 | 84.7 | Free flow mostly, backwater observed |
| In-26 | 5.80 | 0.36 | 16.1 | Free flow mostly |
| INT-2nd St | 18.15 | 3.59 | 5.1 | Free flow mostly, surcharge and backwater during large storms |
| INT-DRI | 4.08 | 1.46 | 2.8 | Severe surcharge and backwater observed |
| INT-Ridley 2 | 14.26 | 3.11 | 4.6 | Free flow mostly, surcharge and backwater observed |
| INT-Ridley 3 | 13.94 | 3.35 | 4.2 | Free flow mostly, surcharge and backwater observed |
| INT-WEI | 11.34 | 1.34 | 8.5 | Free flow mostly |
| Sep-1 | 0.65 | 0.12 | 5.5 | Free flow mostly |
| Sep-2 | 0.54 | 0.11 | 4.8 | Free flow mostly |
| Sep-3 | 1.26 | 0.43 | 2.9 | Free flow mostly |
| Sep-4 | 4.29 | 1.35 | 3.2 | Free flow mostly |
| Side-1 | 8.44 | 2.35 | 3.6 | Free flow mostly, surcharge and backwater observed |
| Side-2 | 0.68 | 0.21 | 3.2 | Free flow mostly |

## Figure 10: Dry Weather Flow Balance Schematic

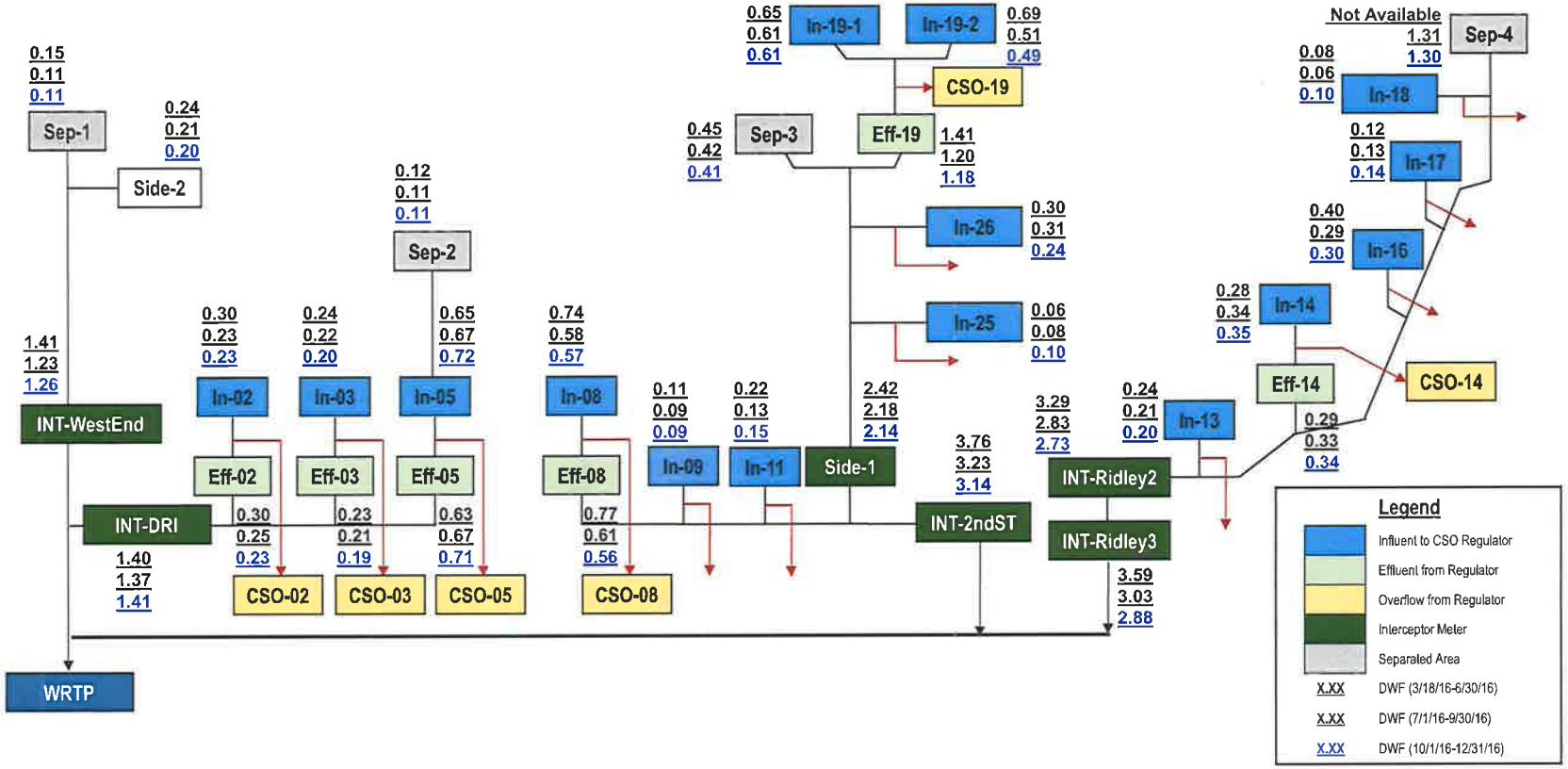
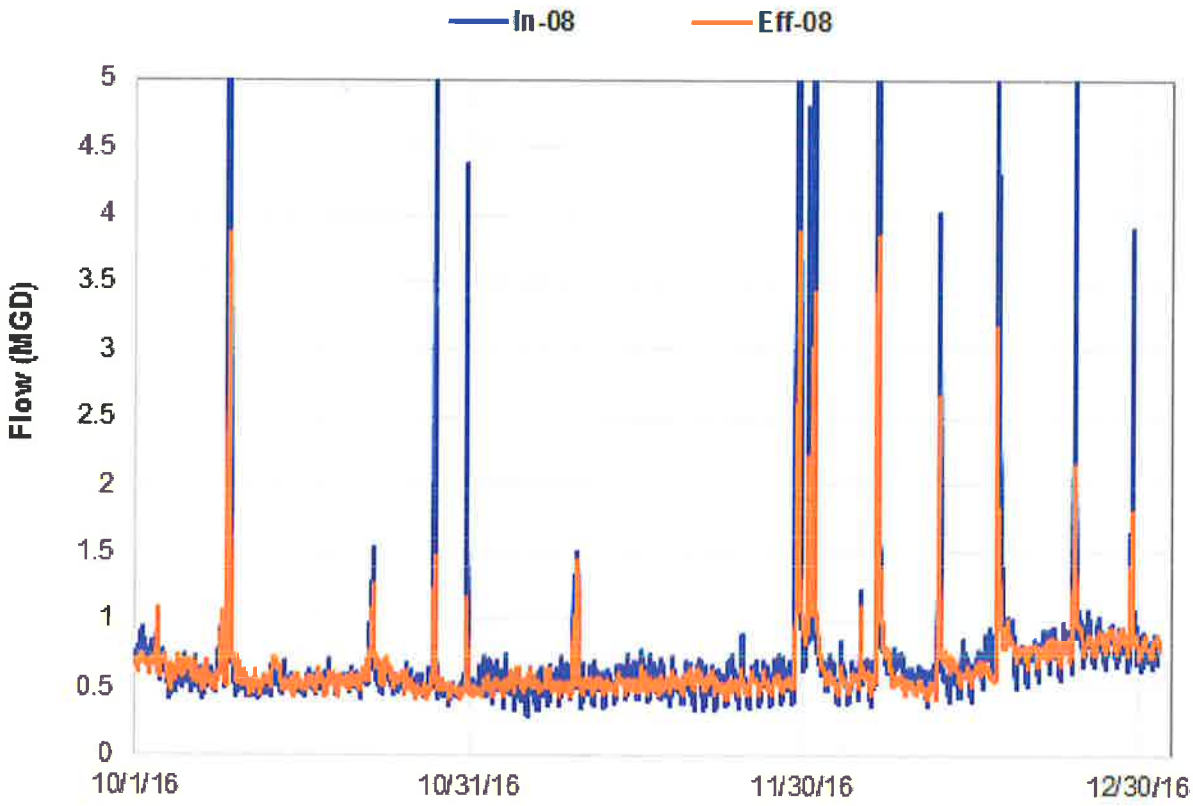
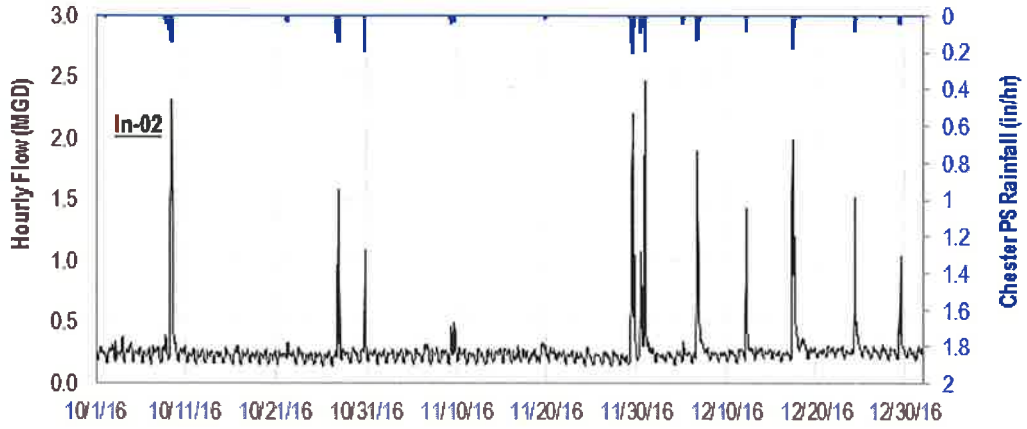


**Figure 11: Flow Hydrograph In-08 and Eff-08**

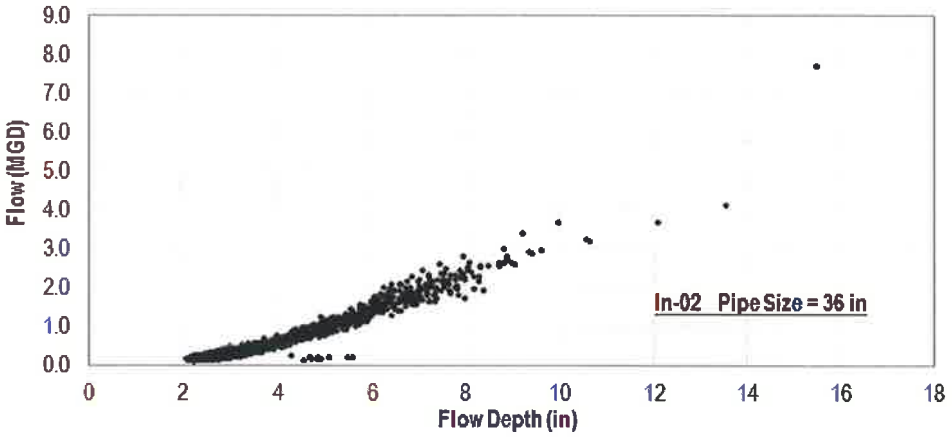


## Figure 12: Flow Monitoring Data, In-02

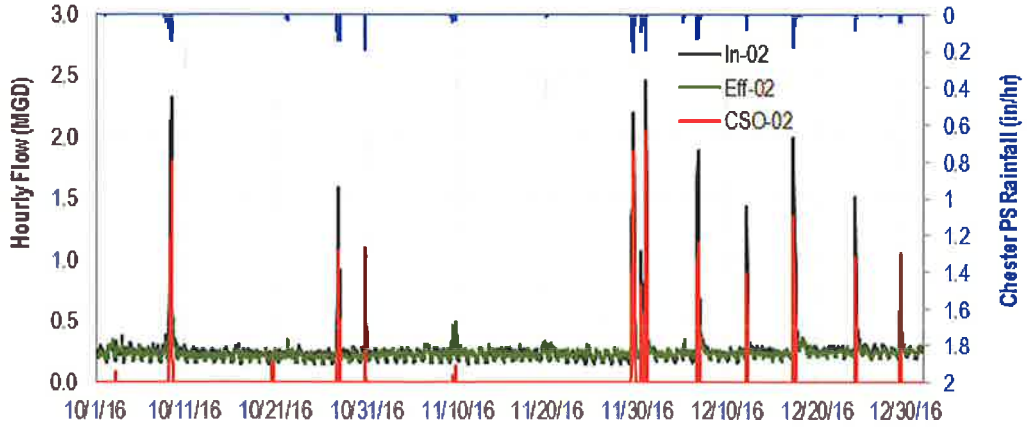
**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

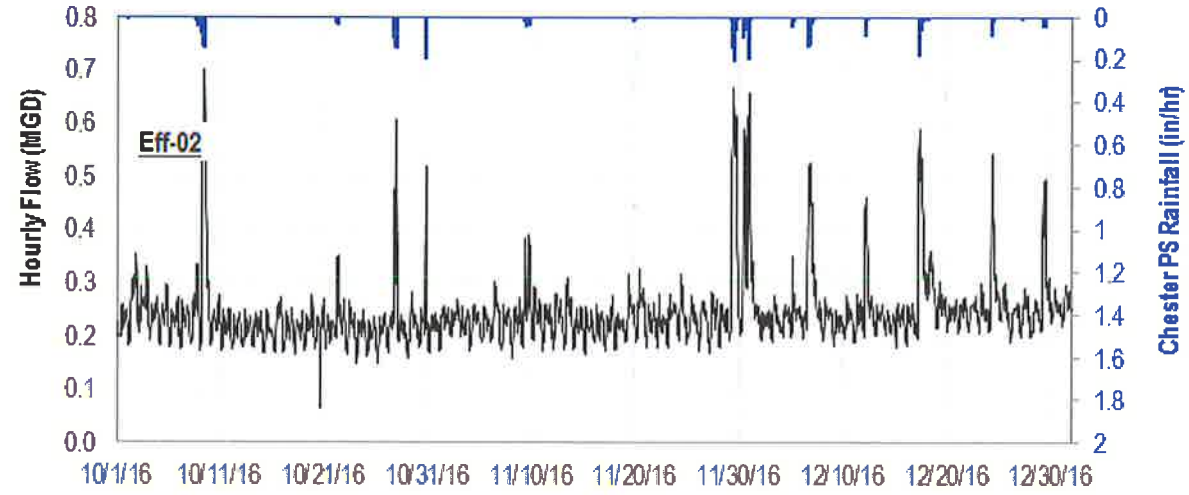



**CSO#02 Influent , Effluent and Overflow**

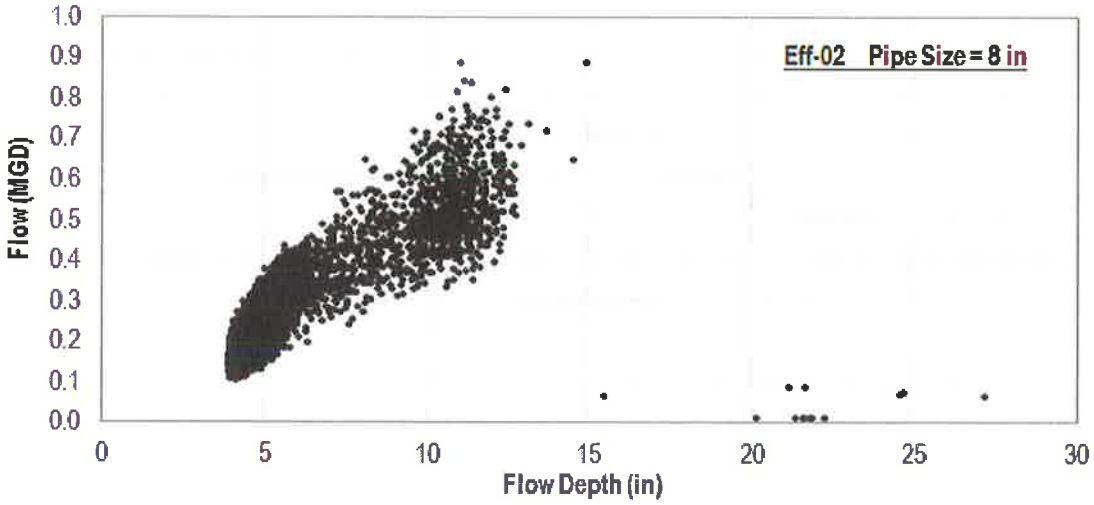


## Figure 13: Flow Monitoring Data, EFF-02

**Hourly Hydrograph**

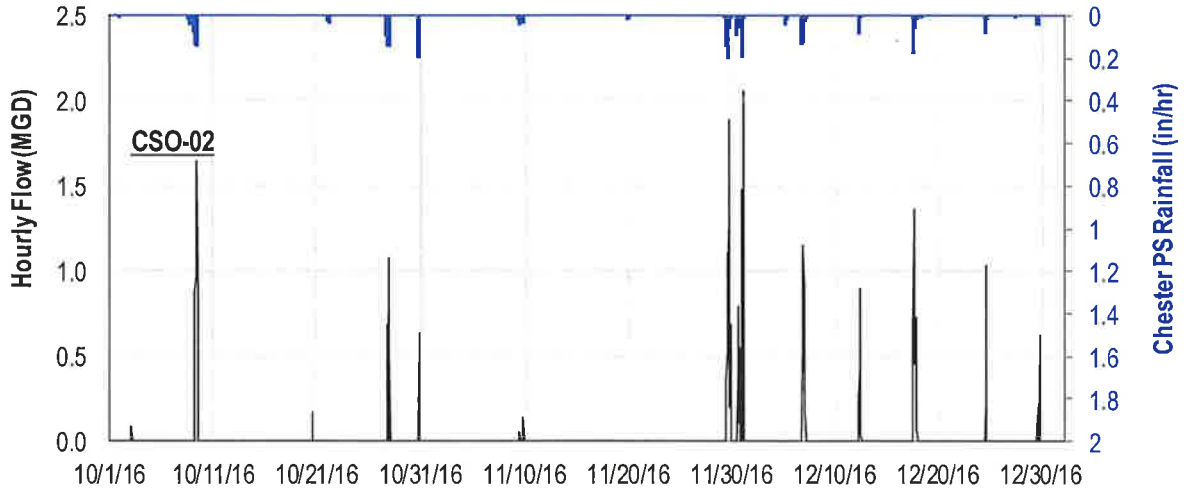



**Scattergraph (Flow vs. Depth)**

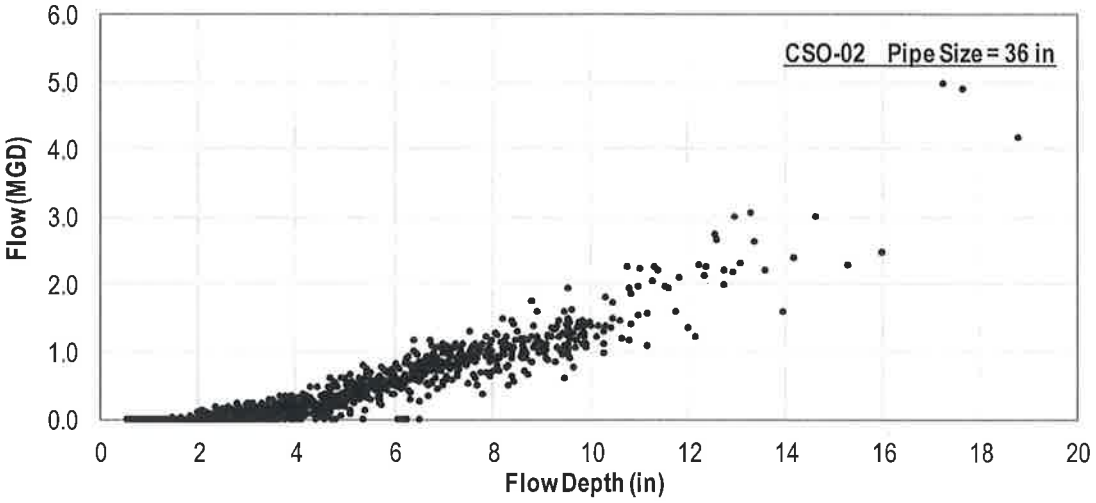


## Figure 14: Flow Monitoring Data, CSO-02

**Hourly Hydrograph**

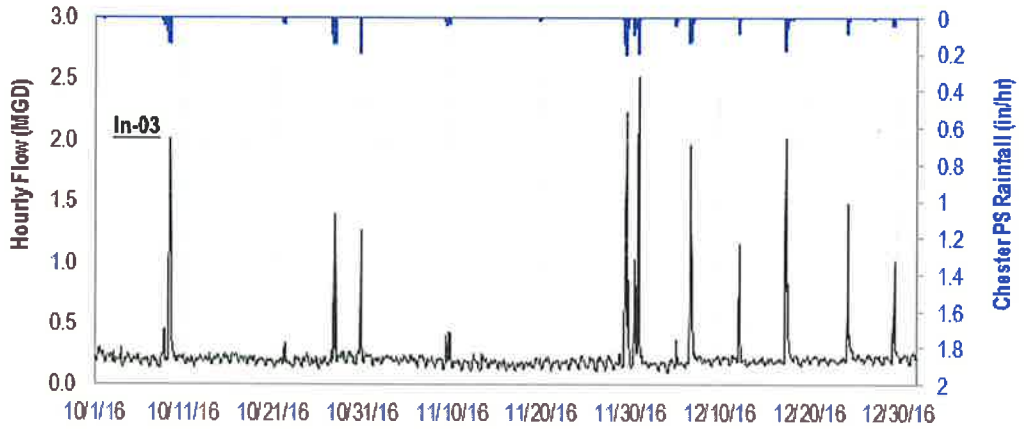



**Scattergraph (Flow vs. Depth)**

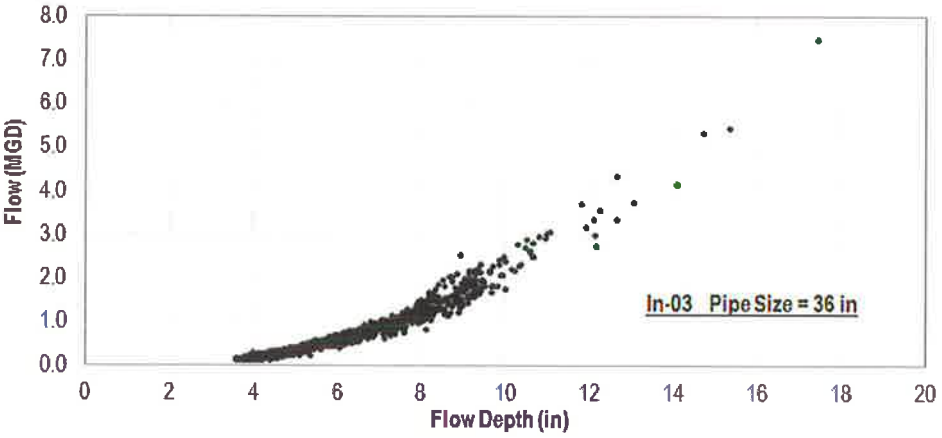


## Figure 15: Flow Monitoring Data, IN-03

**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**




**CSO#03 Influent , Effluent and Overflow**

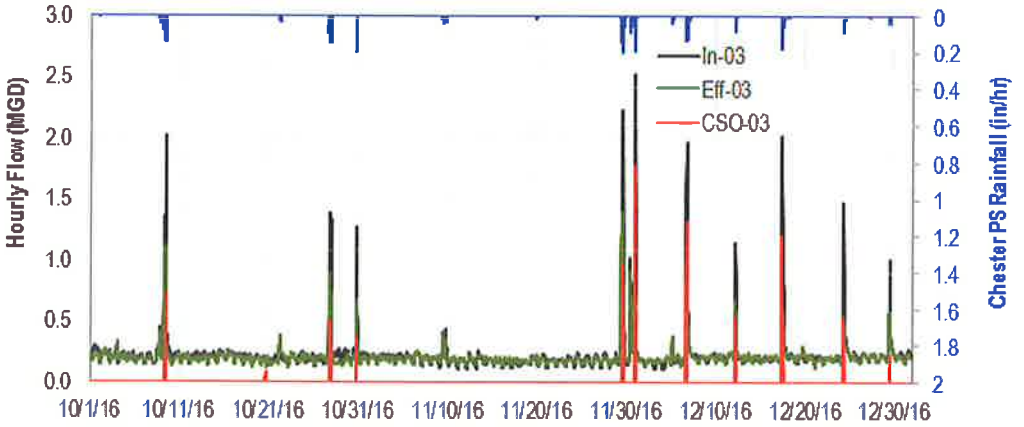
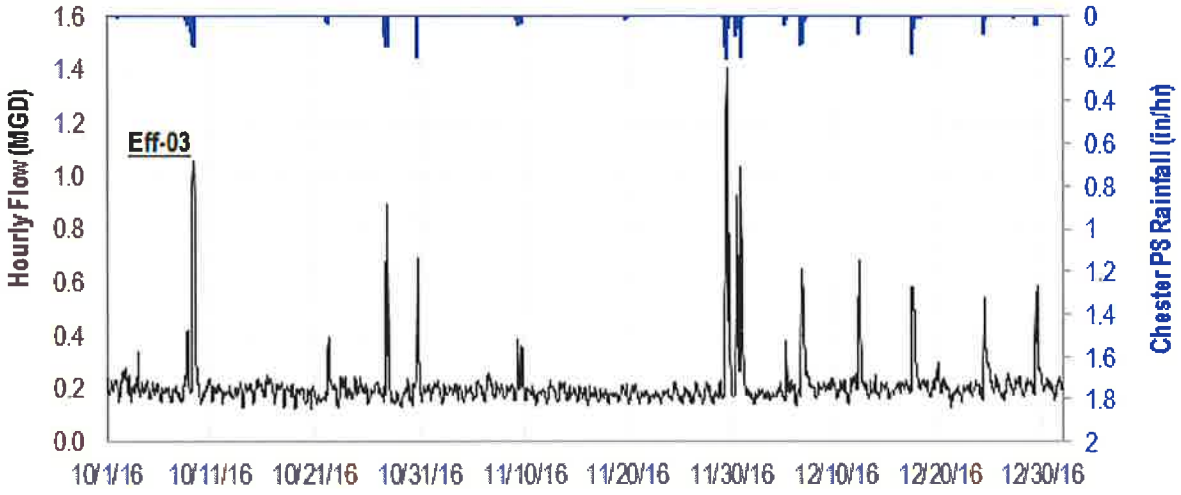
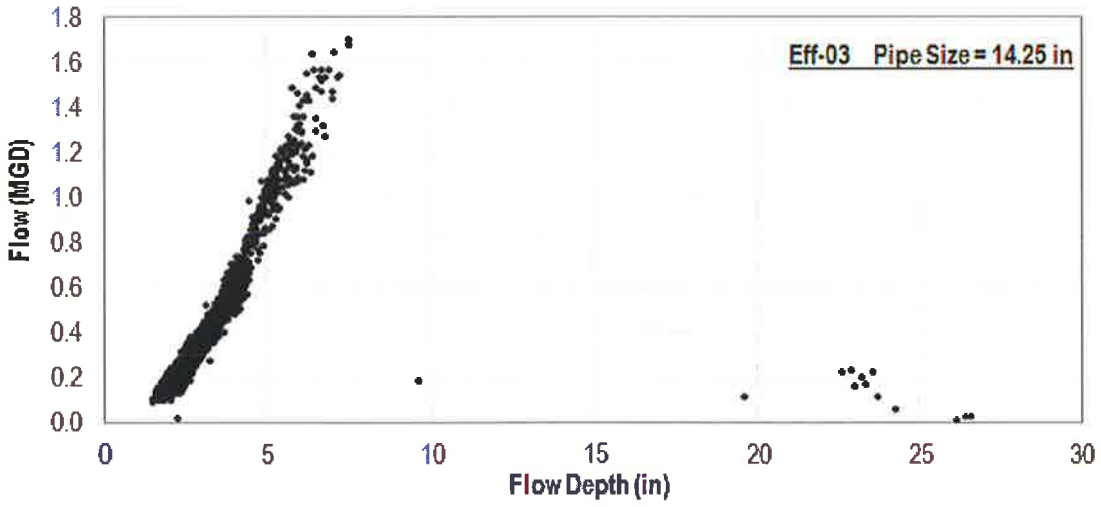


**Figure 16: Flow Monitoring Data, Eff-03**

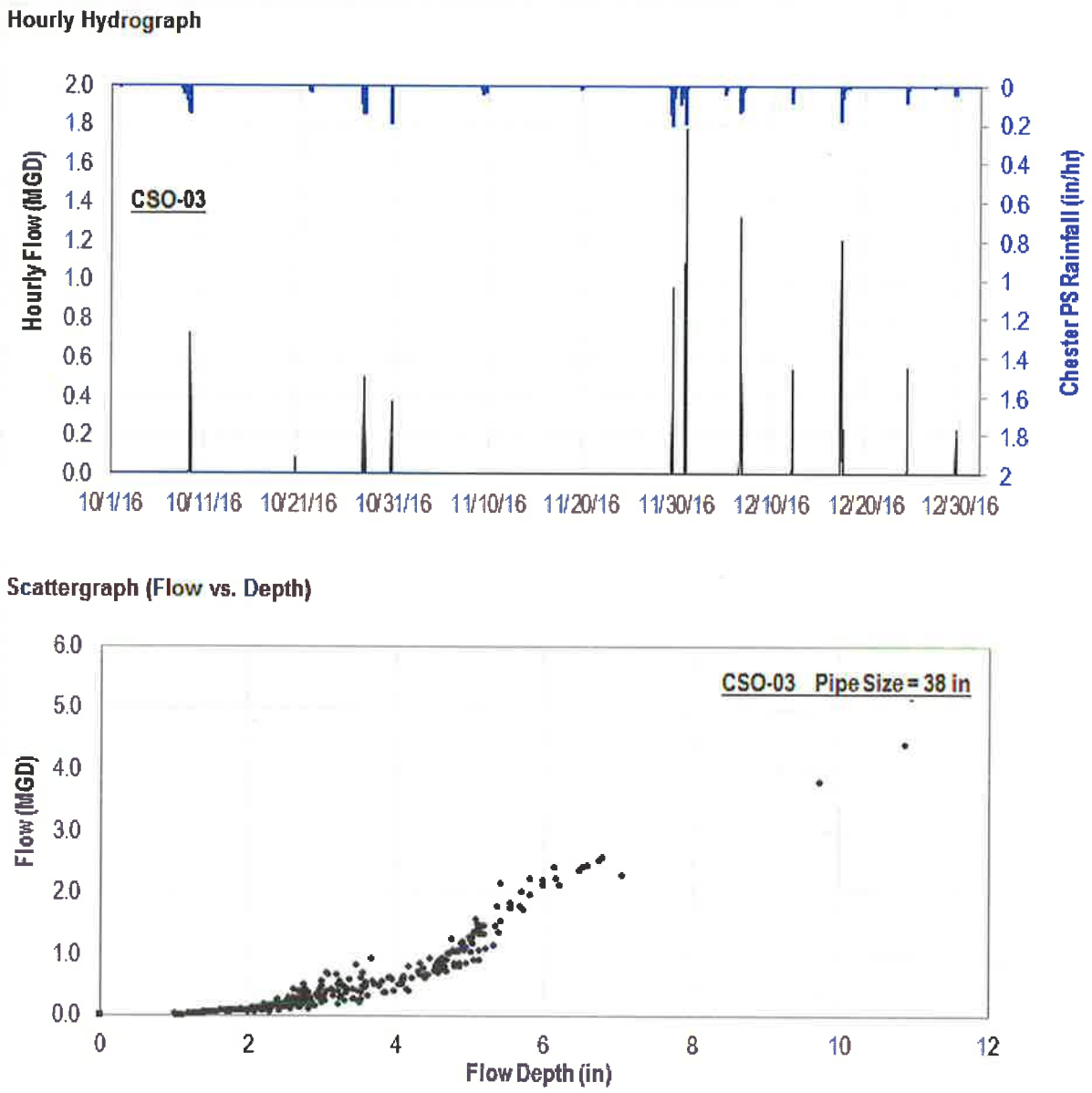
**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

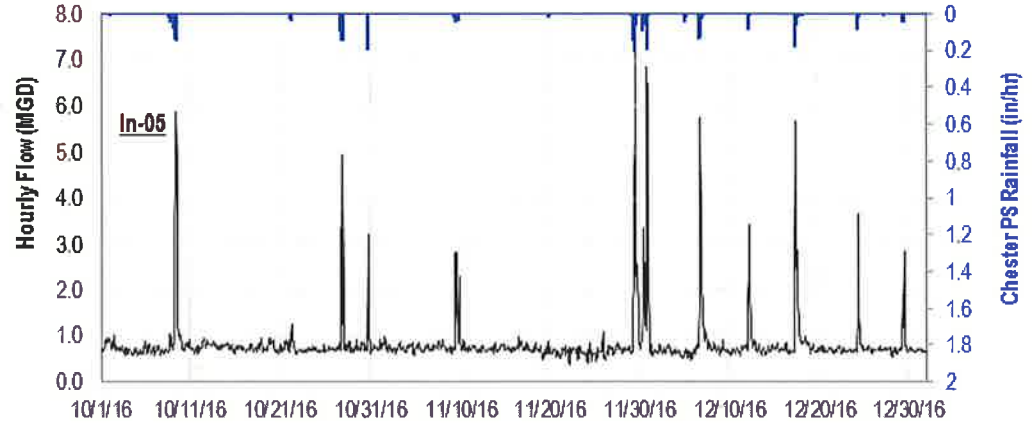


## Figure 17: Flow Monitoring Data, CSO-03

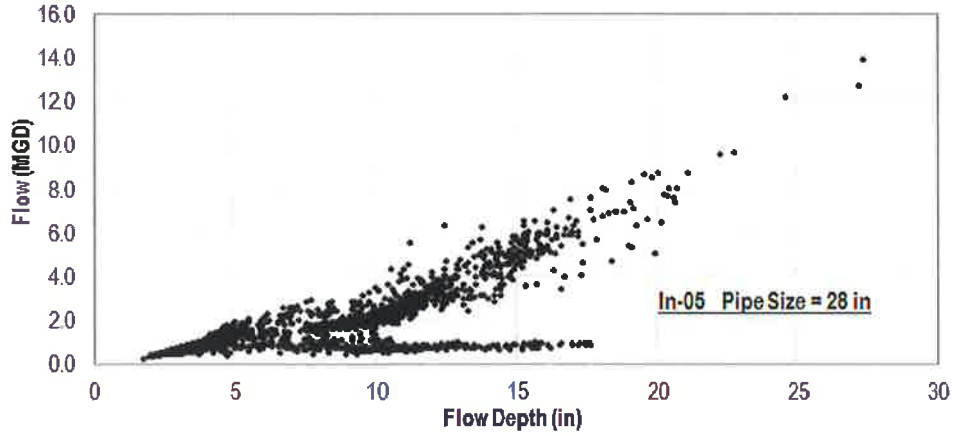


## Figure 18: Flow Monitoring Data, IN-05

**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**




**CSO#05 Influent , Effluent and Overflow**

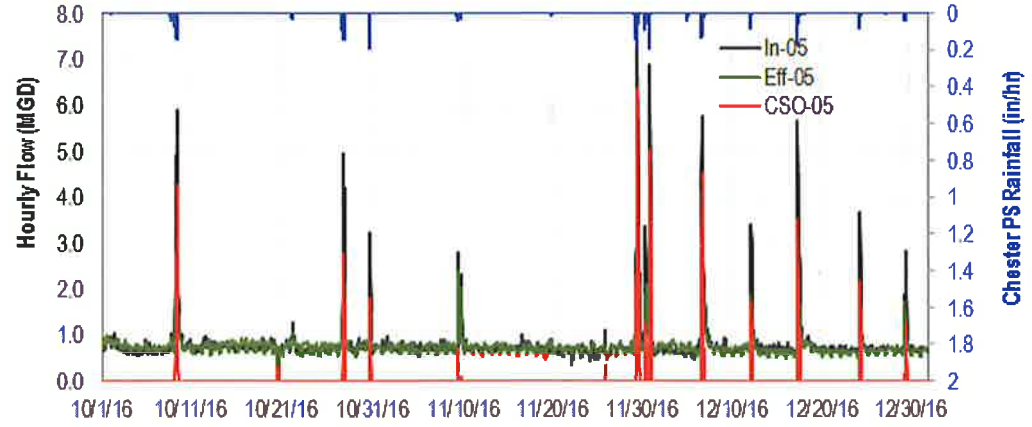
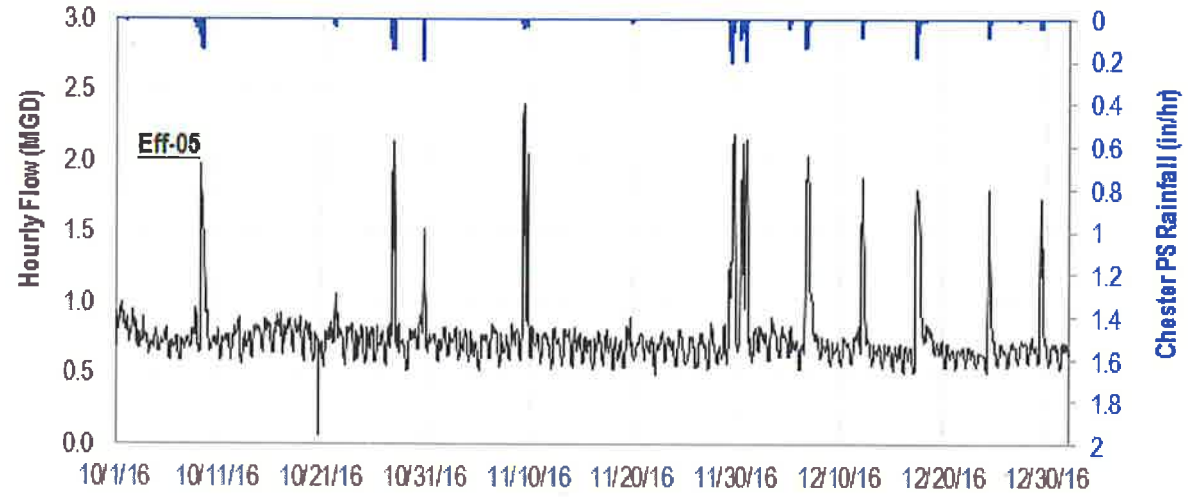
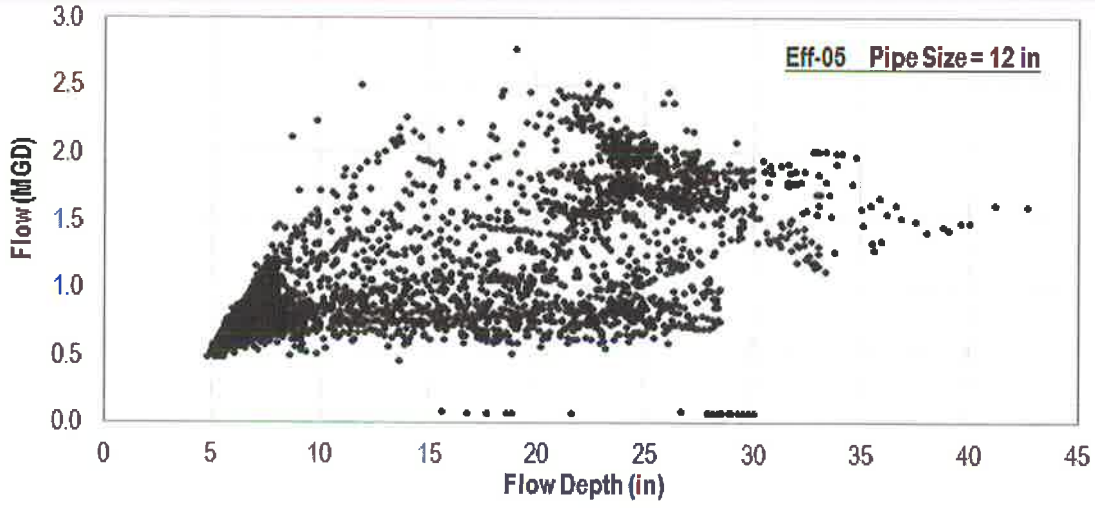


**Figure 19: Flow Monitoring Data, Eff-05**

**Hourly Hydrograph**

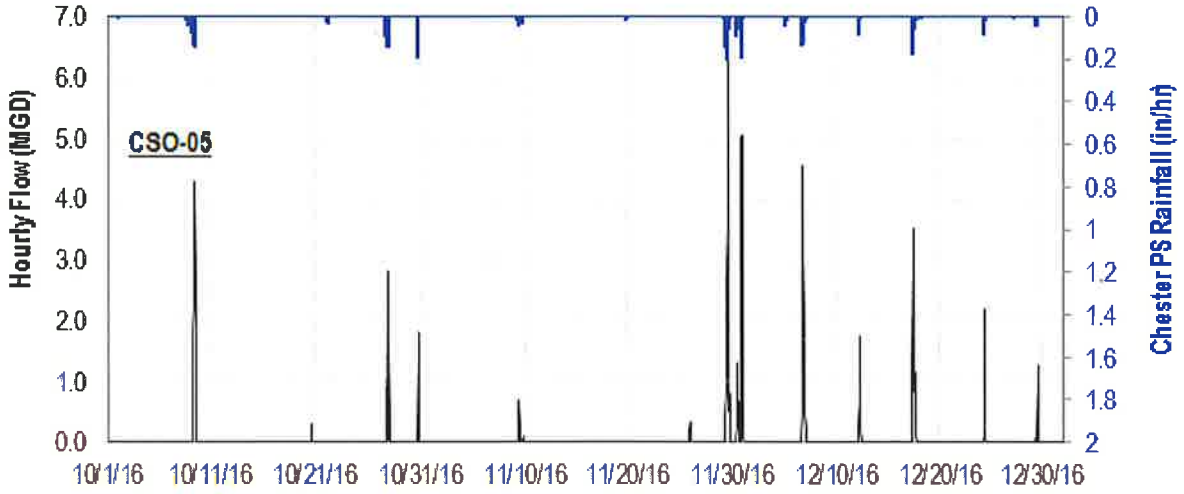



**Scattergraph (Flow vs. Depth)**

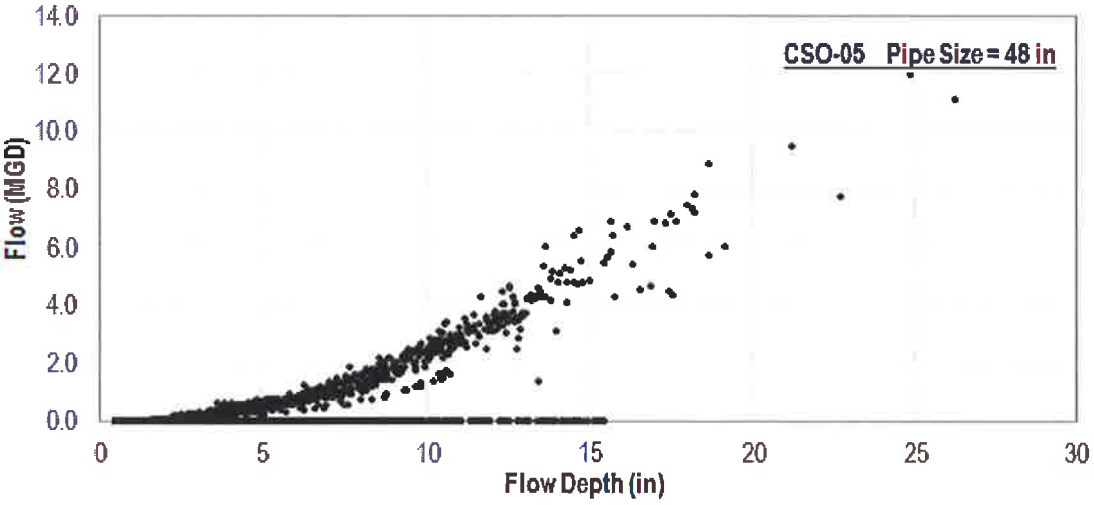


## Figure 20: Flow Monitoring Data, CSO-05

**Hourly Hydrograph**

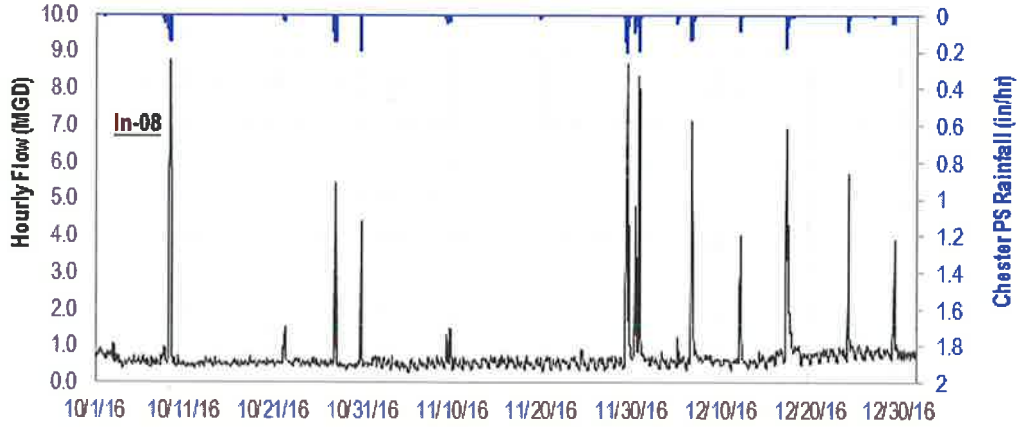



**Scattergraph (Flow vs. Depth)**

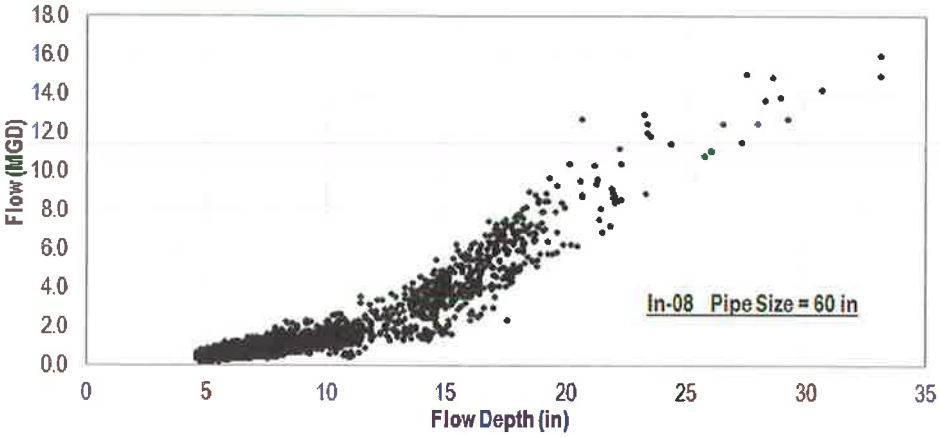


## Figure 21: Flow Monitoring Data, IN-08

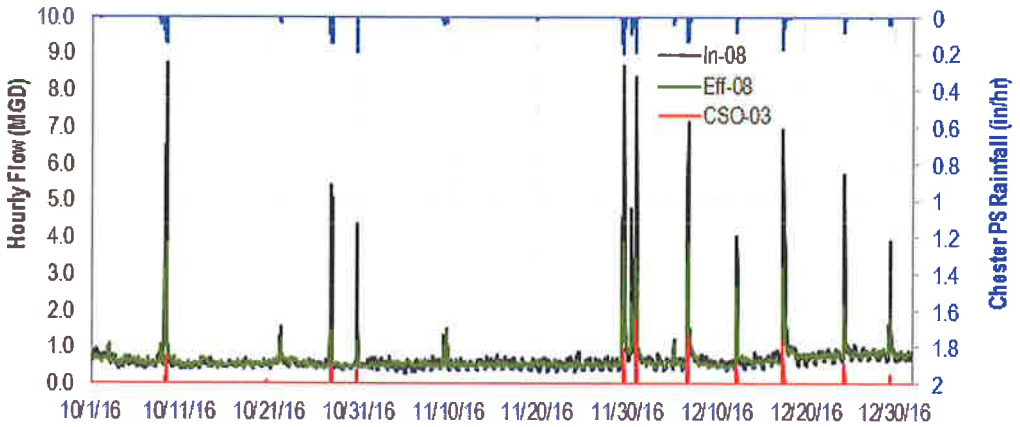
**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

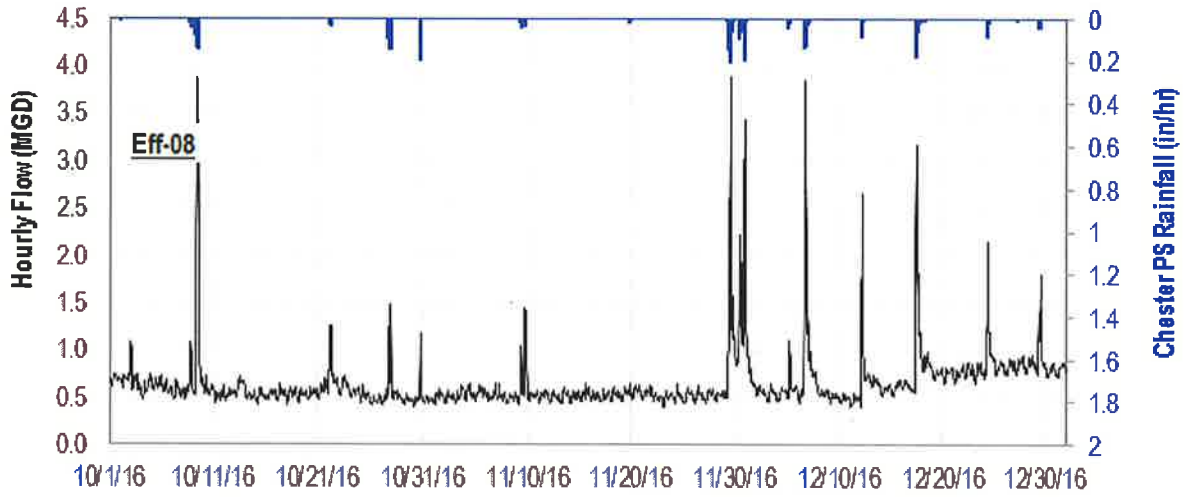



**CSO#08 Influent , Effluent and Overflow**



## Figure 22: Flow Monitoring Data, Eff-08

Hourly Hydrograph




Scattergraph (Flow vs. Depth)

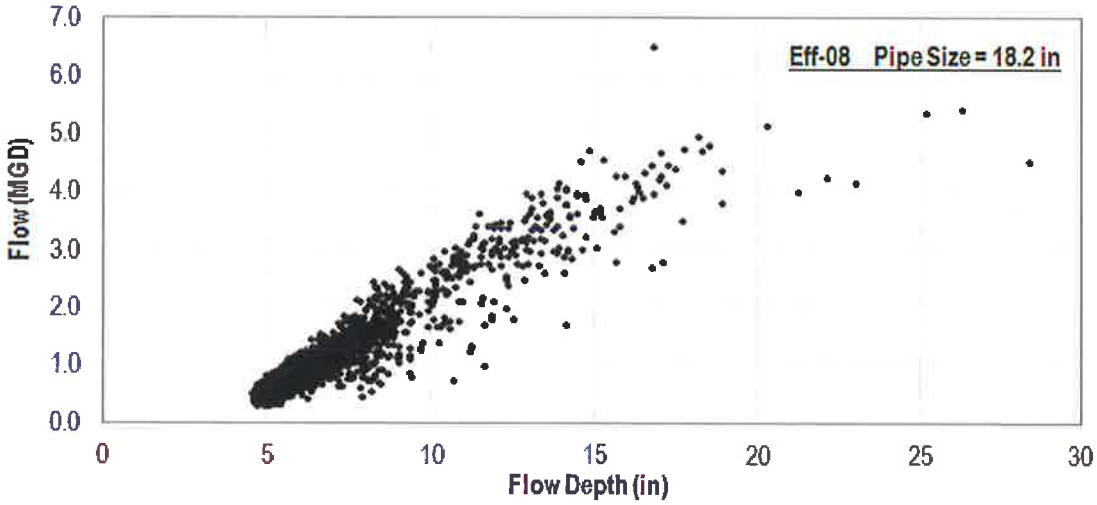
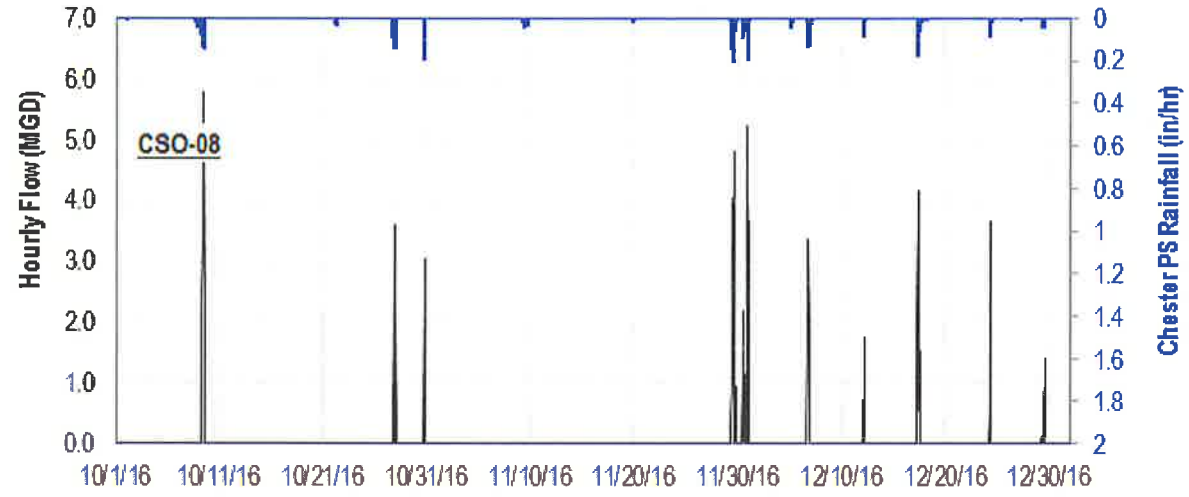
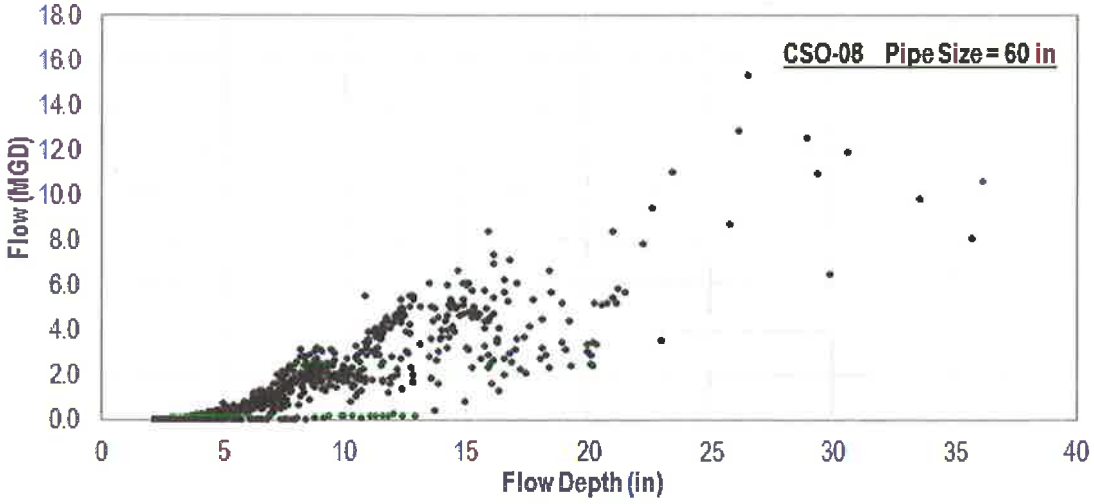


**Figure 23: Flow Monitoring Data, CSO-08**

**Hourly Hydrograph**

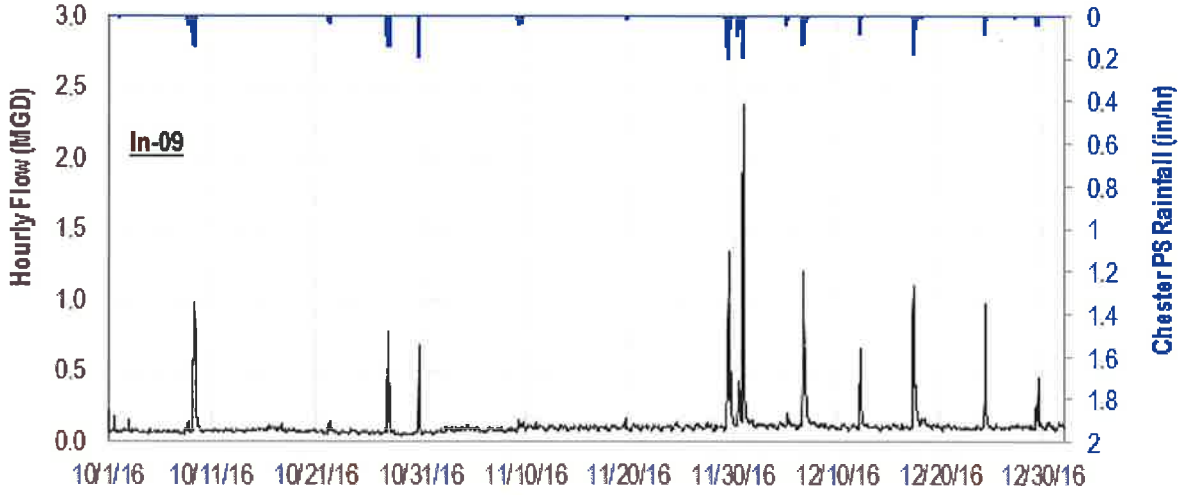



**Scattergraph (Flow vs. Depth)**

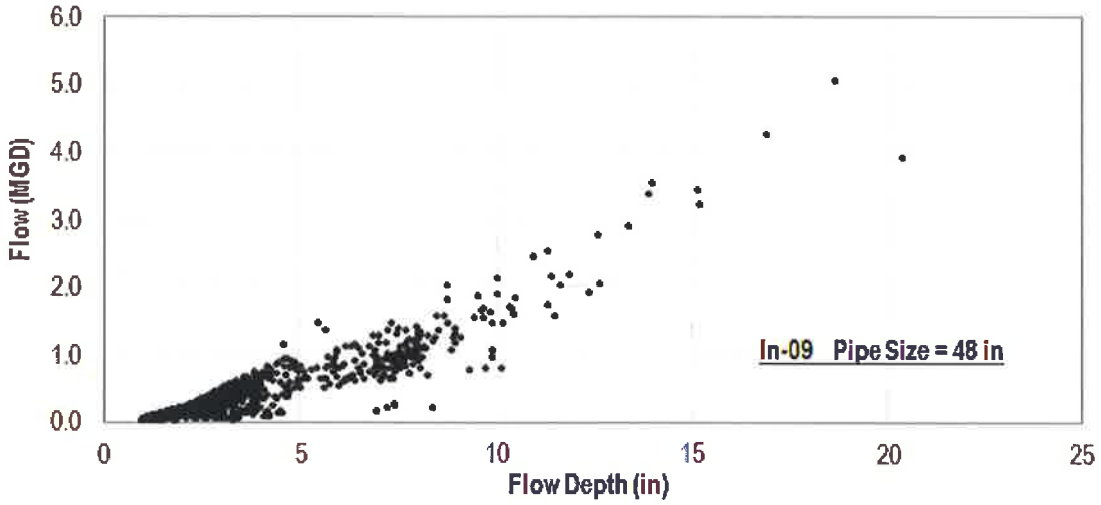


## Figure 24: Flow Monitoring Data, In-09

**Hourly Hydrograph**

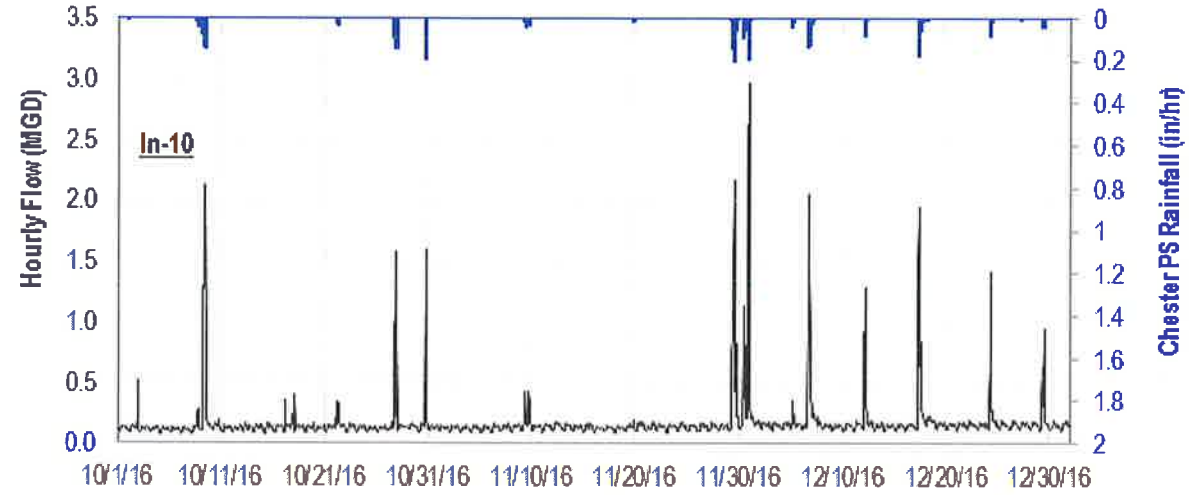



**Scattergraph (Flow vs. Depth)**



## Figure 25: Flow Monitoring Data, In-10

Hourly Hydrograph




Scattergraph (Flow vs. Depth)

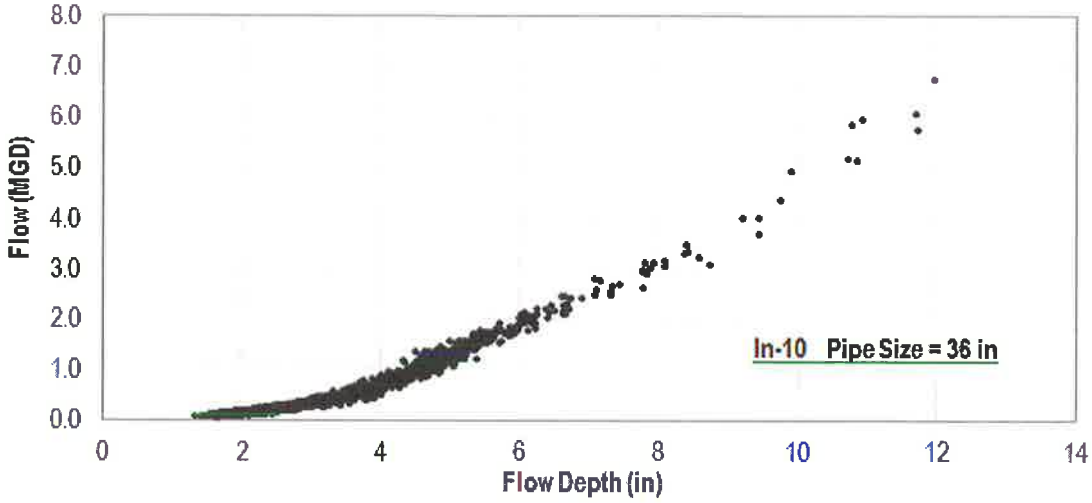
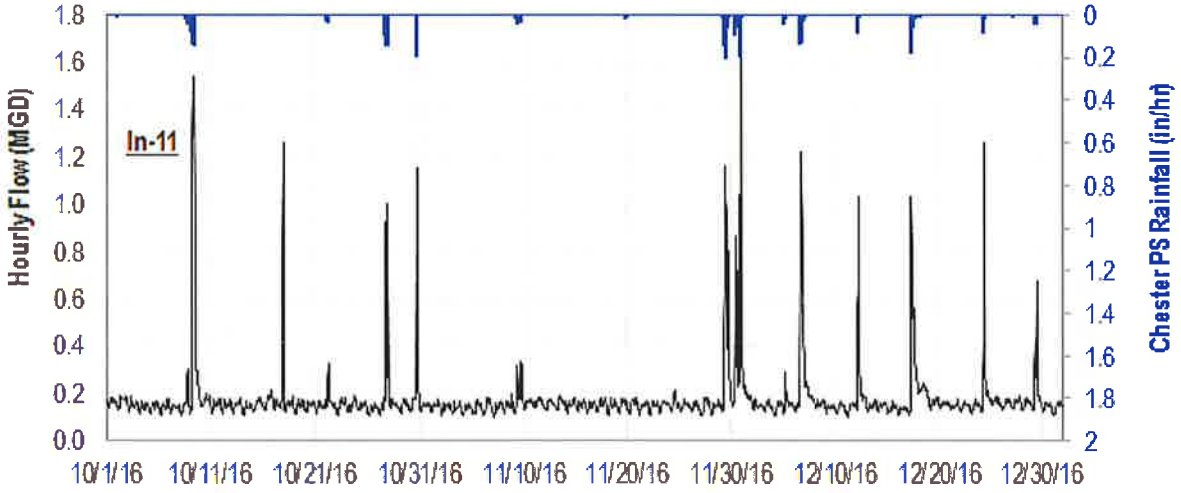


**Figure 26: Flow Monitoring Data, In-11**

**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

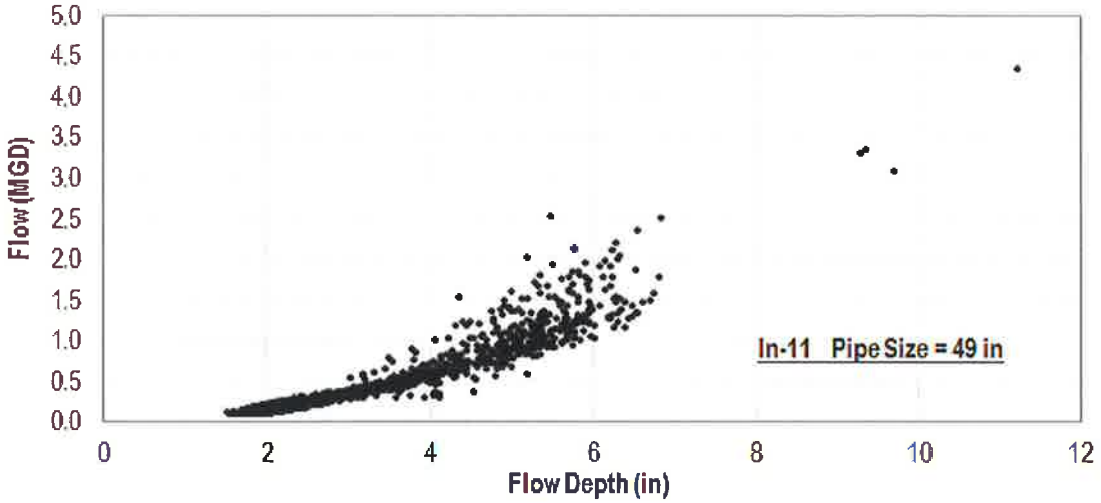
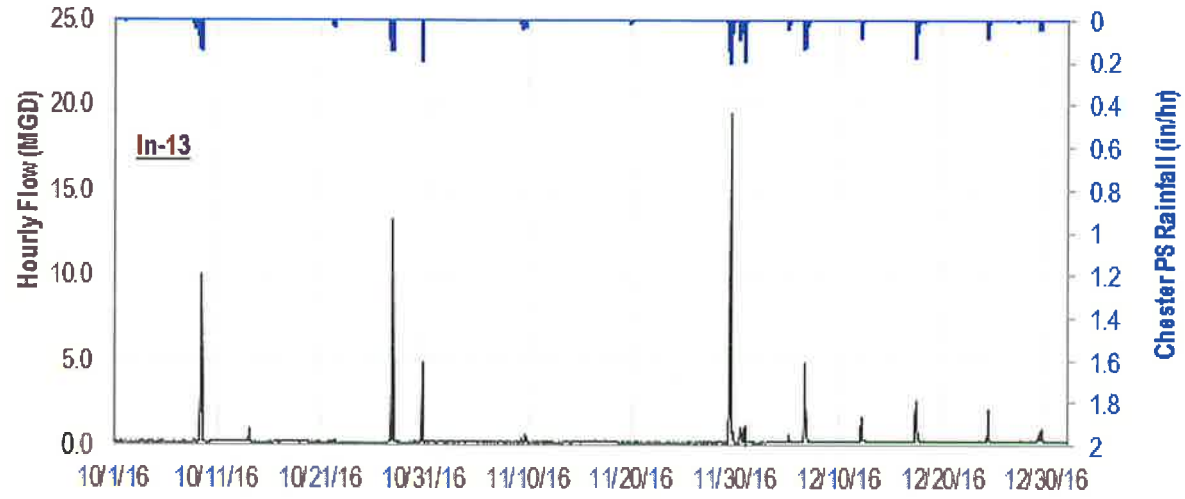
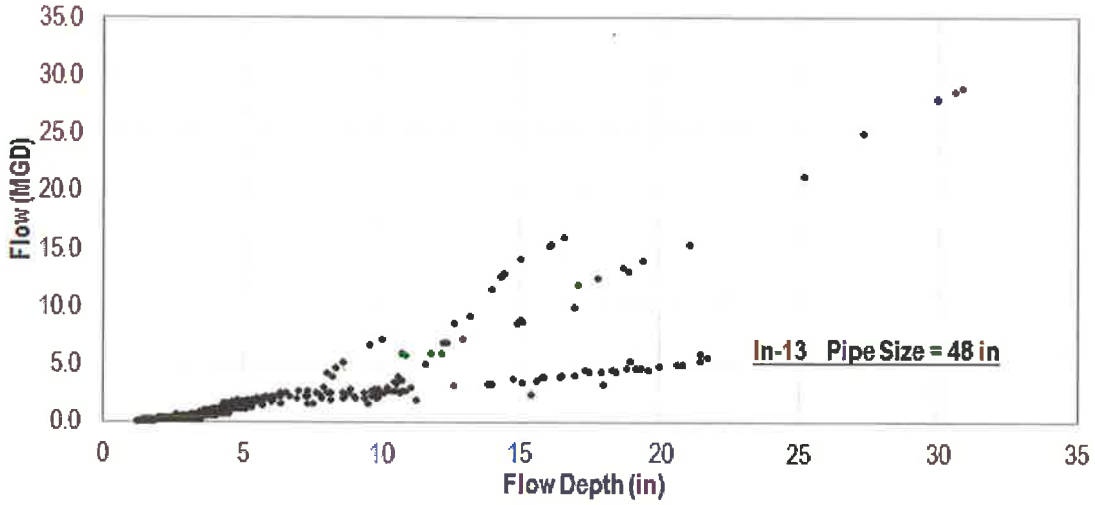


Figure 27: Flow Monitoring Data, In-13

Hourly Hydrograph

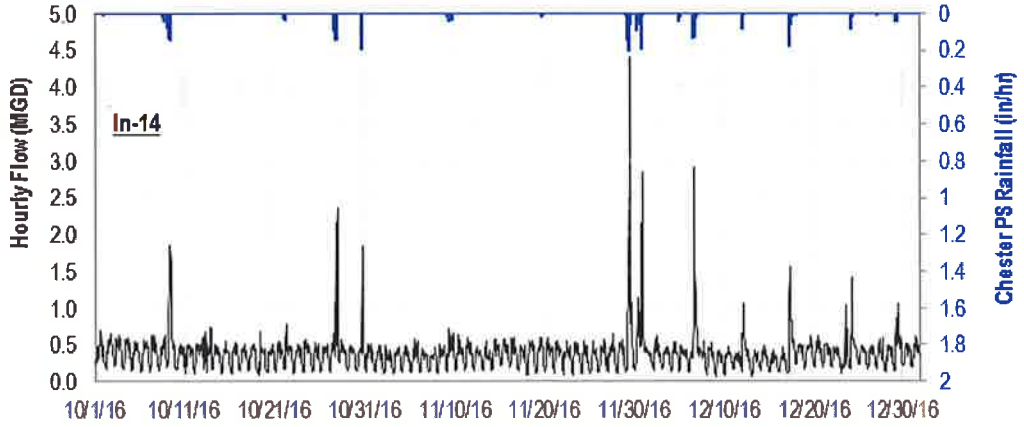



Scattergraph (Flow vs. Depth)

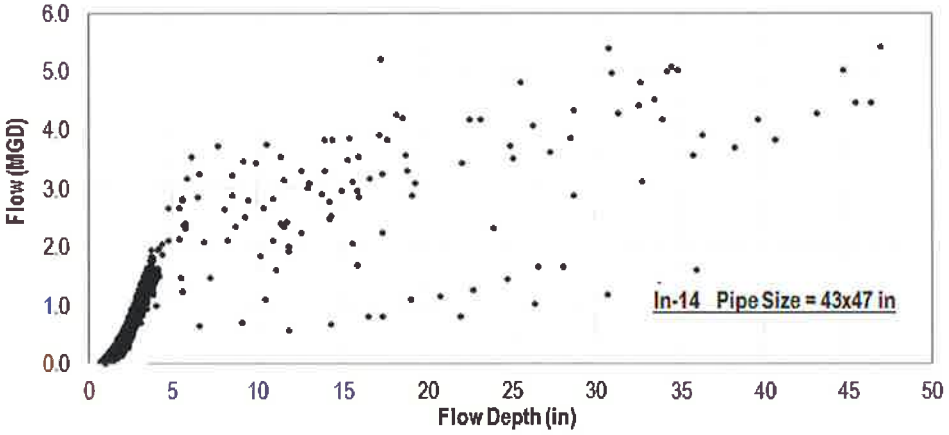


## Figure 28: Flow Monitoring Data, In-14

**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**




**CSO#14 Influent , Effluent and Overflow**

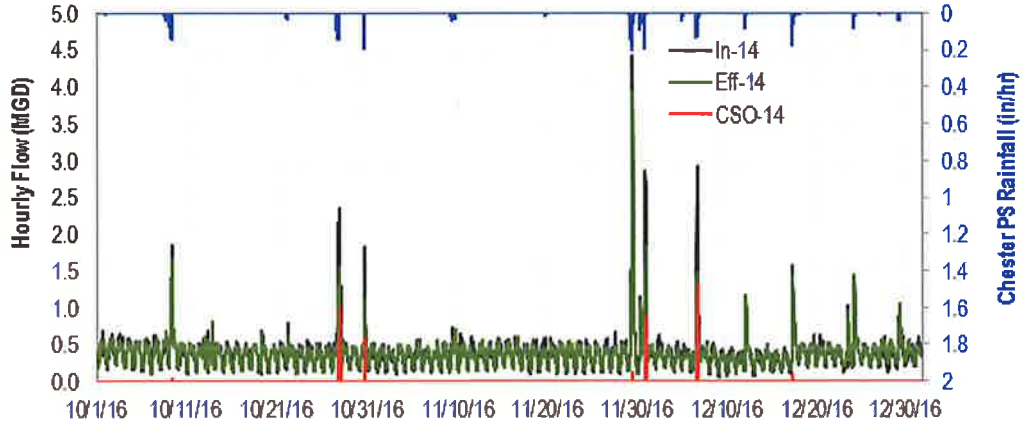
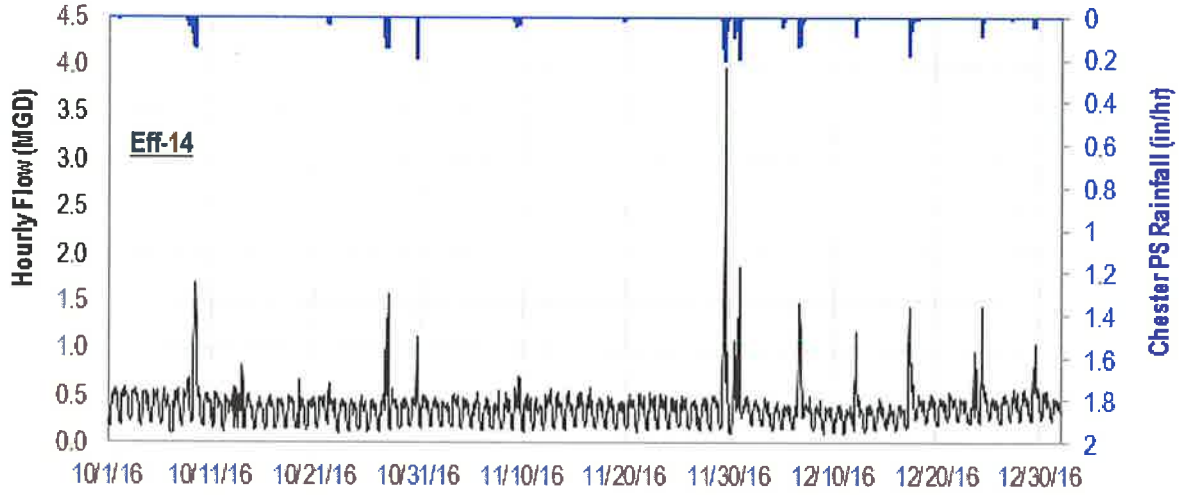
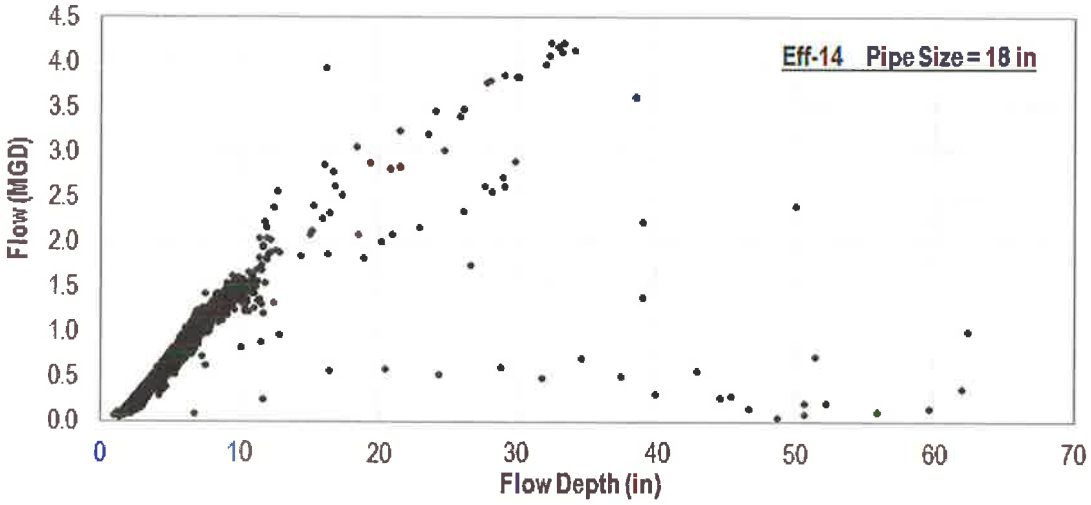


**Figure 29: Flow Monitoring Data, Eff-14**

Hourly Hydrograph

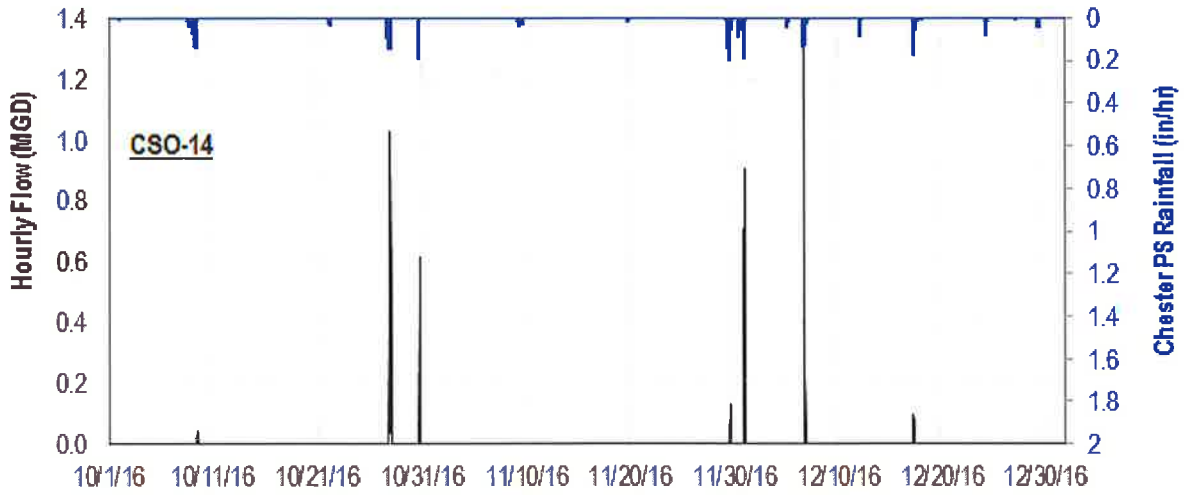



Scattergraph (Flow vs. Depth)

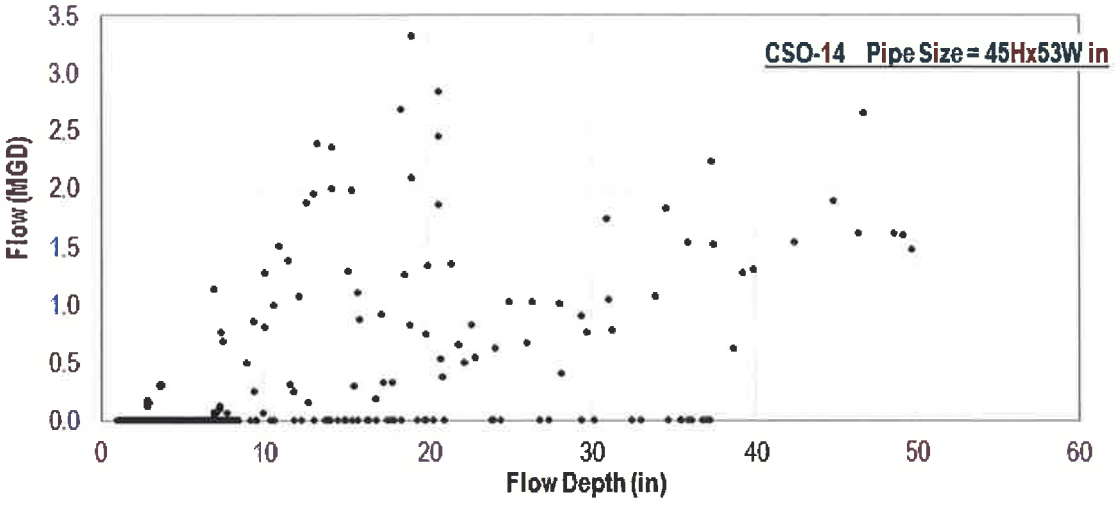


## Figure 30: Flow Monitoring Data, CSO-14

**Hourly Hydrograph**

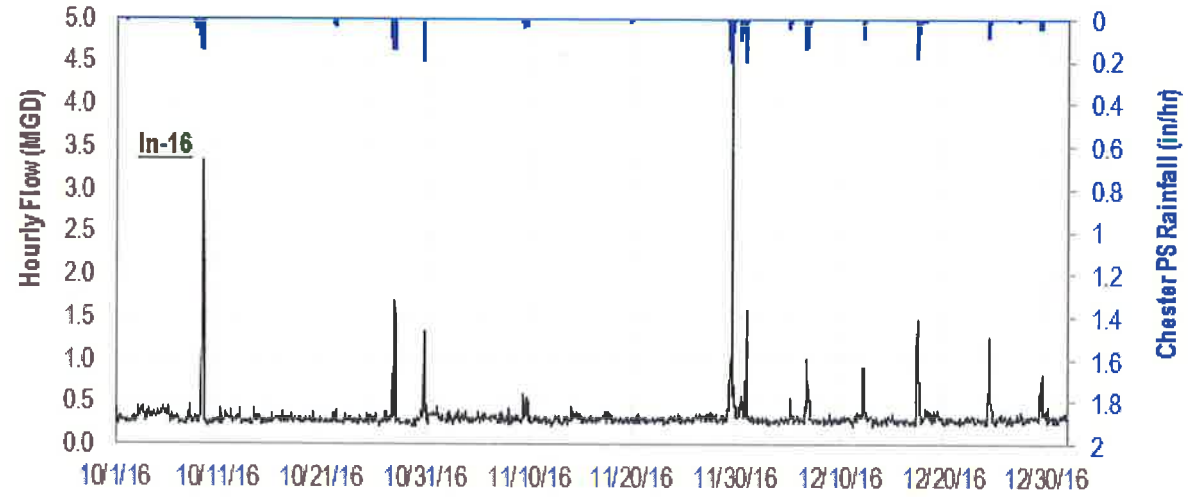



**Scattergraph (Flow vs. Depth)**

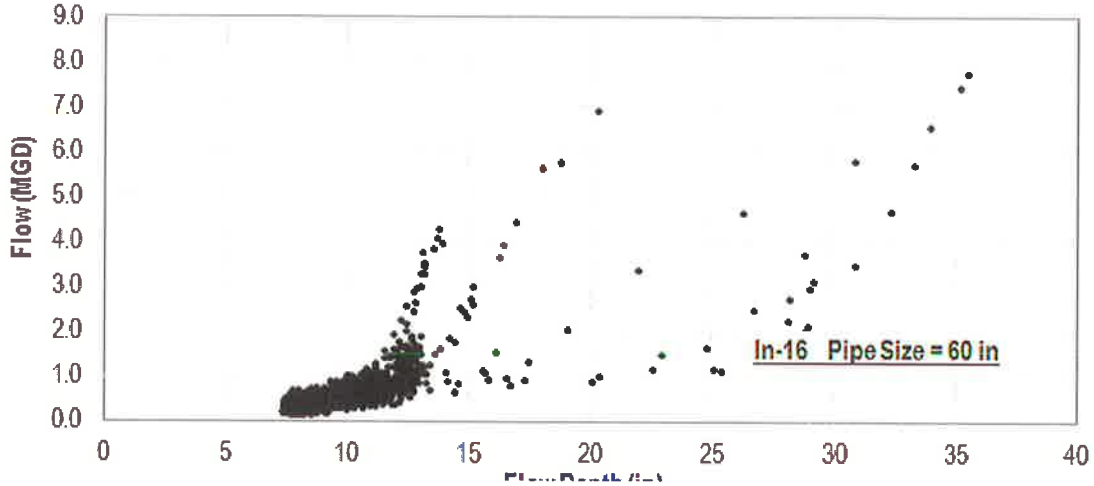


## Figure 31: Flow Monitoring Data, In-16

**Hourly Hydrograph**

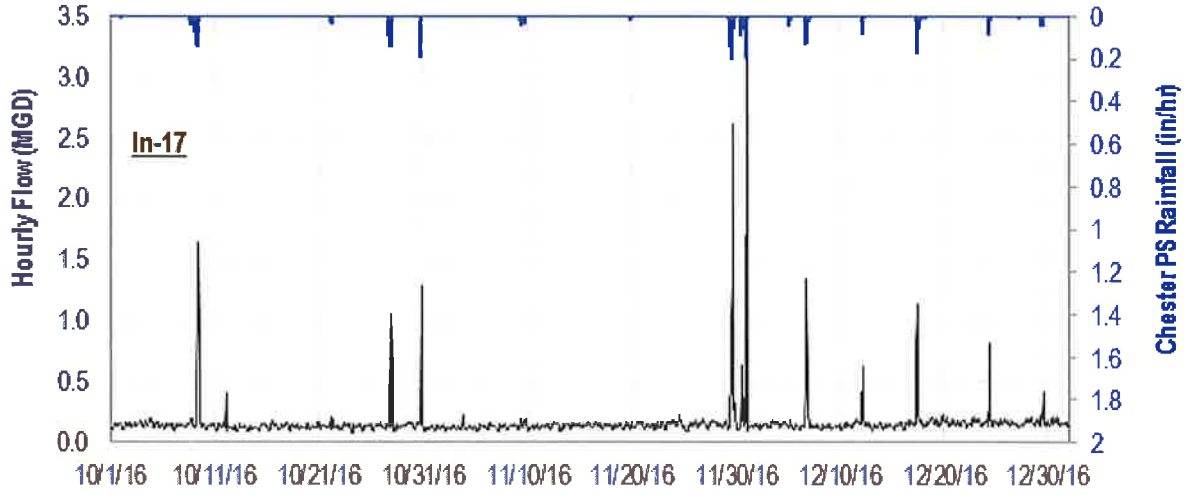



**Scattergraph (Flow vs. Depth)**



## Figure 32: Flow Monitoring Data, In-17

Hourly Hydrograph




Scattergraph (Flow vs. Depth)

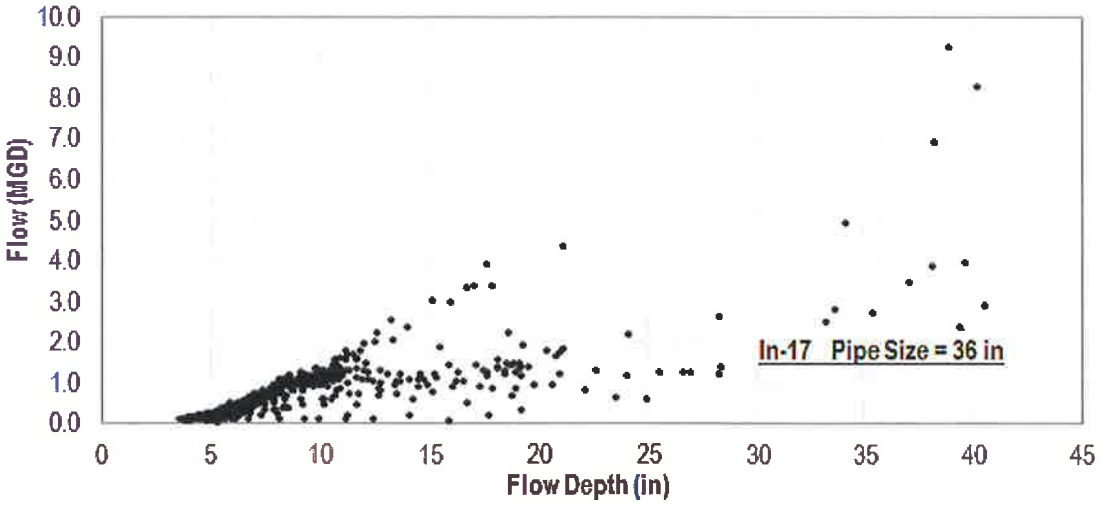
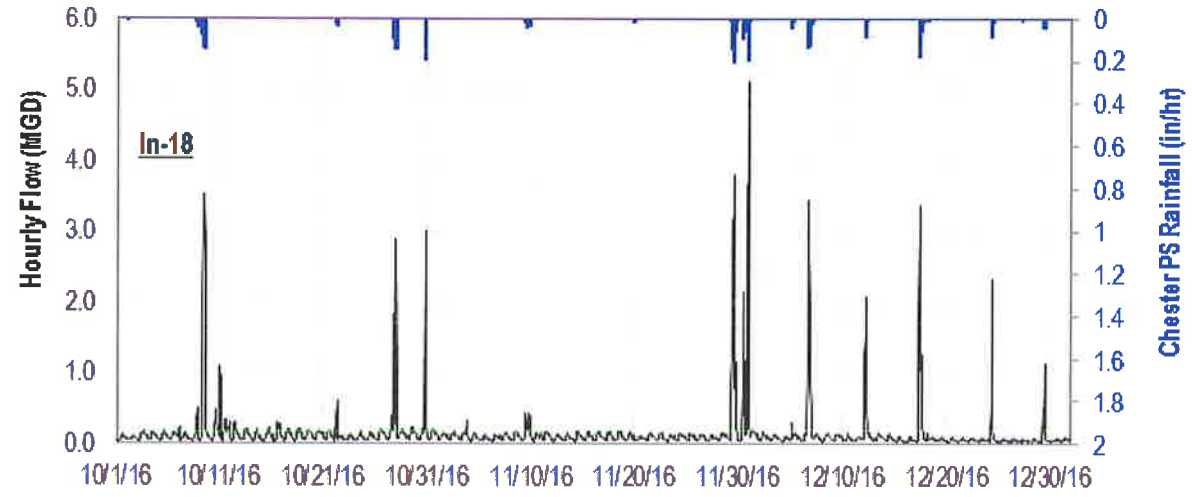
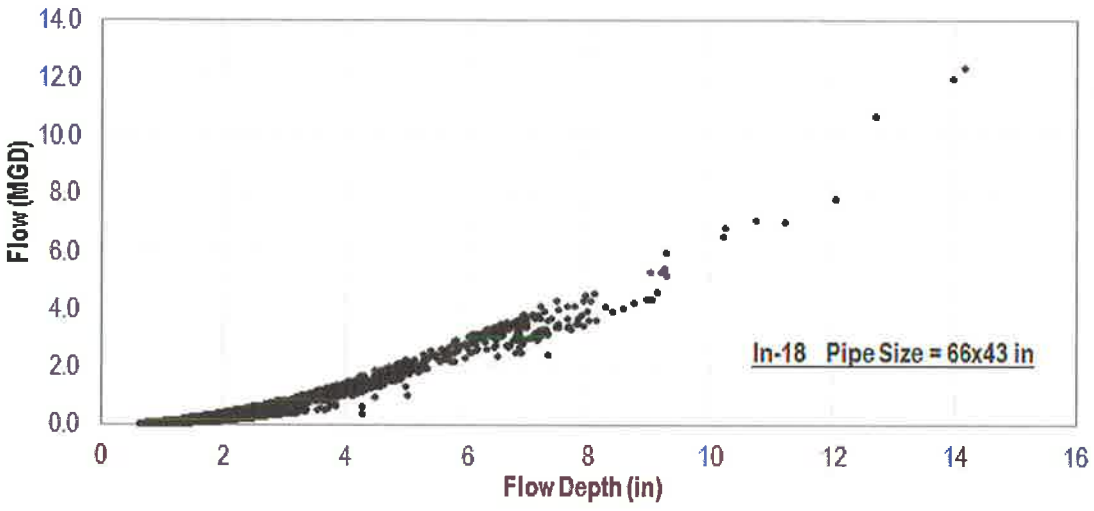


**Figure 33: Flow Monitoring Data, In-18**

Hourly Hydrograph

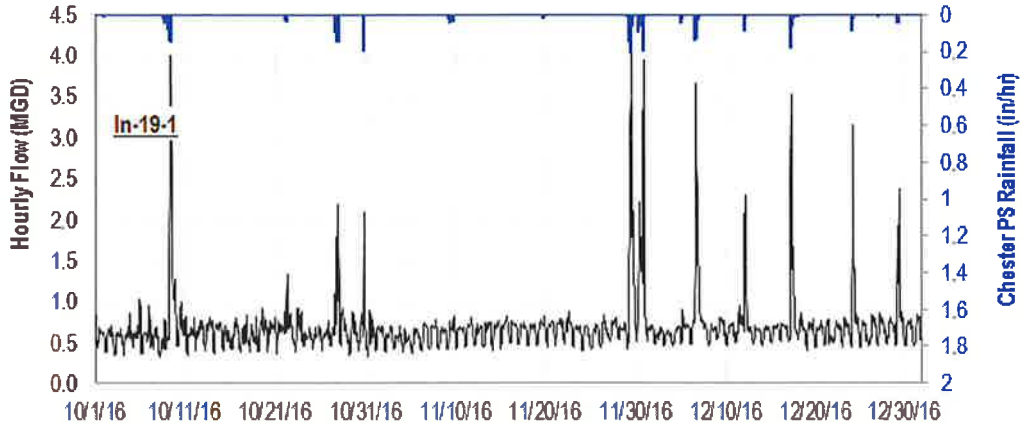



Scattergraph (Flow vs. Depth)

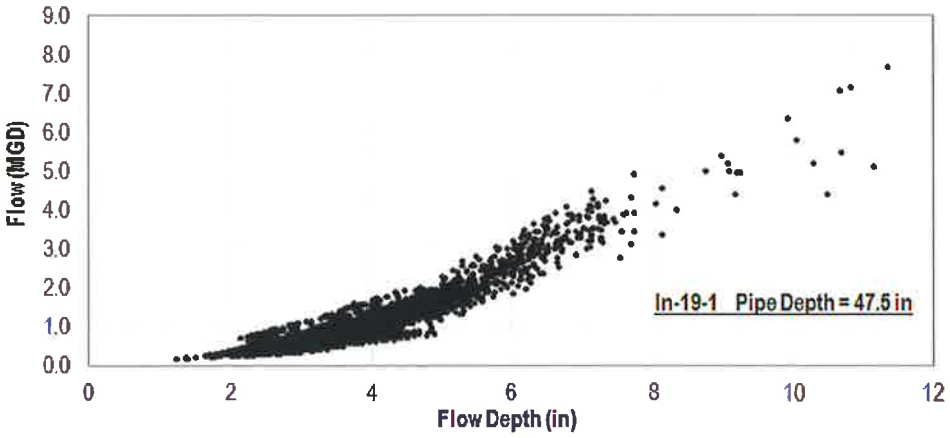


## Figure 34: Flow Monitoring Data, In-19-1

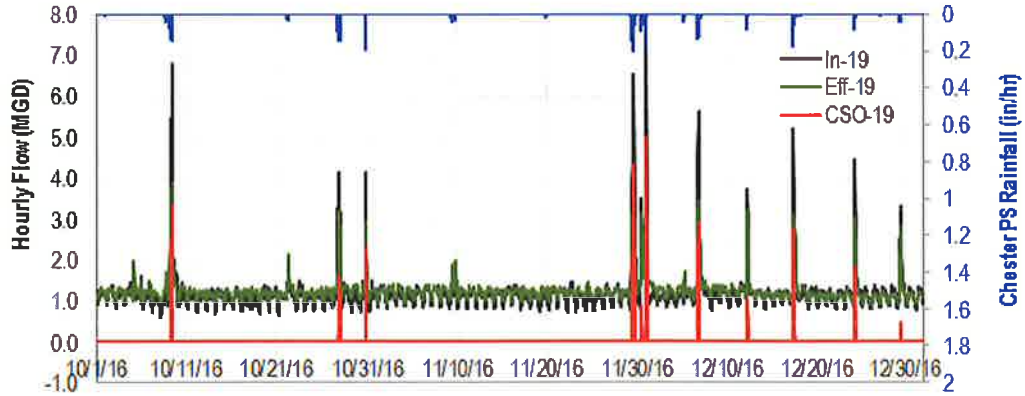
**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

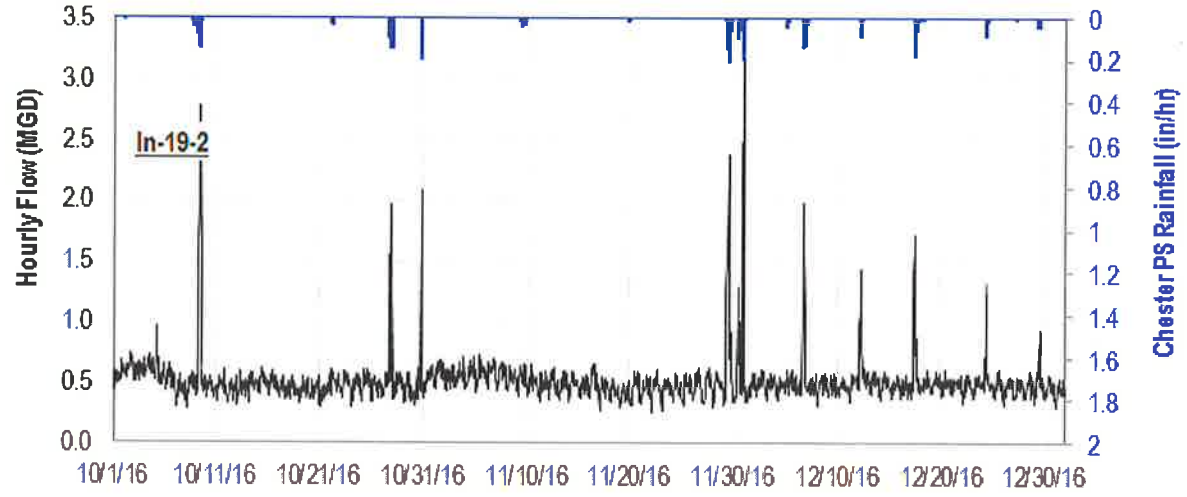



**CSO#19 Influent , Effluent and Overflow**



## Figure 35: Flow Monitoring Data, In-19-2

**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

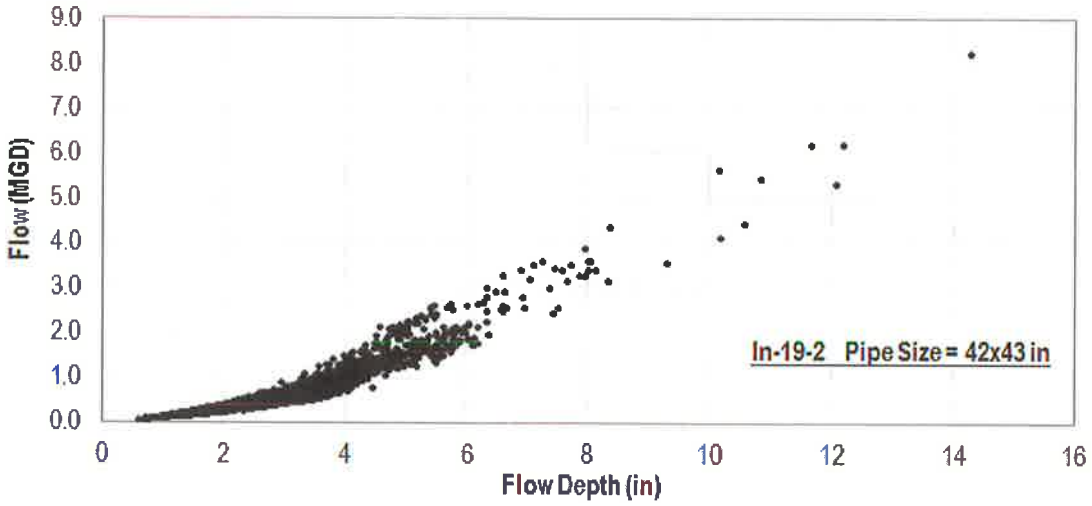
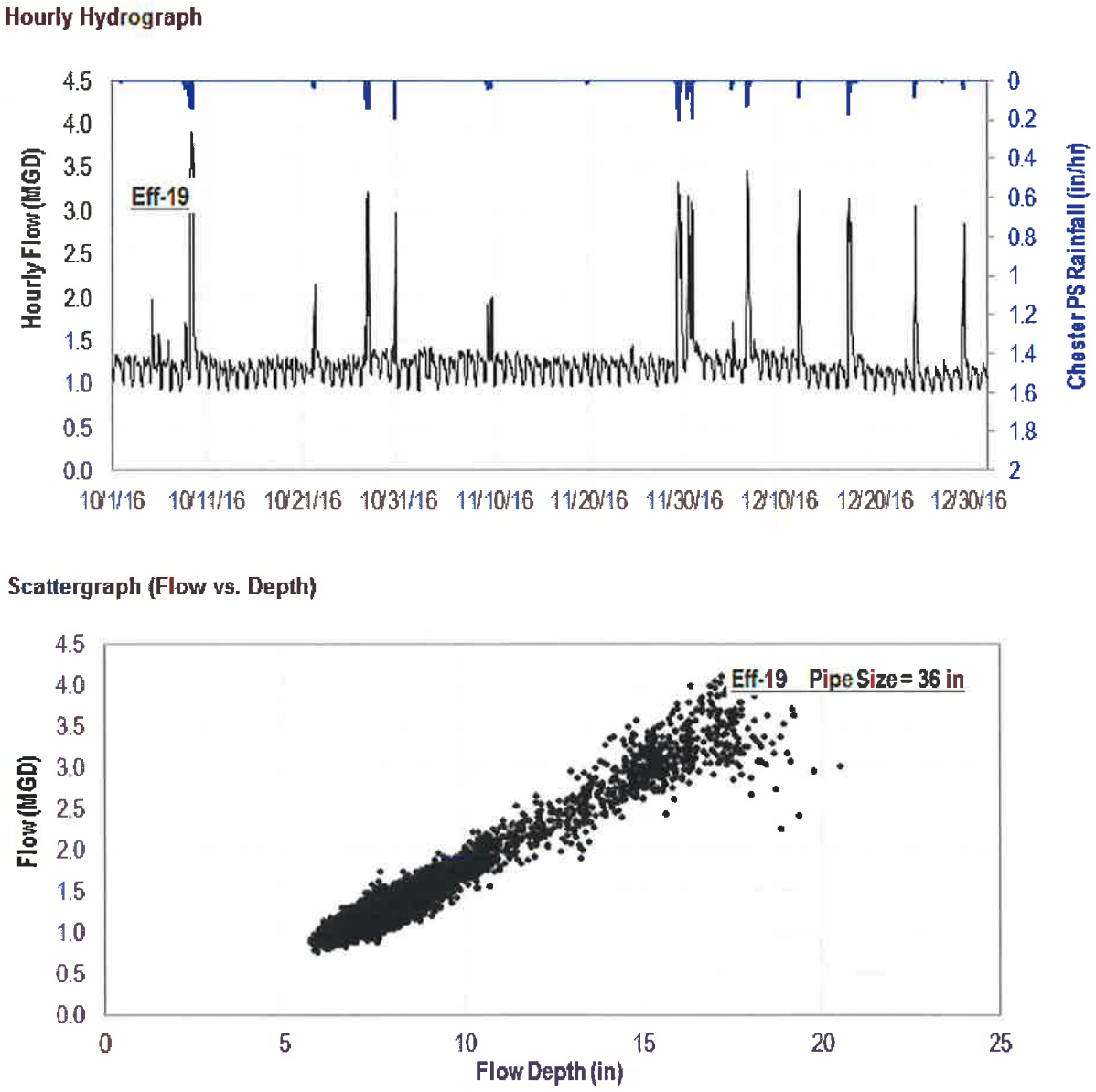
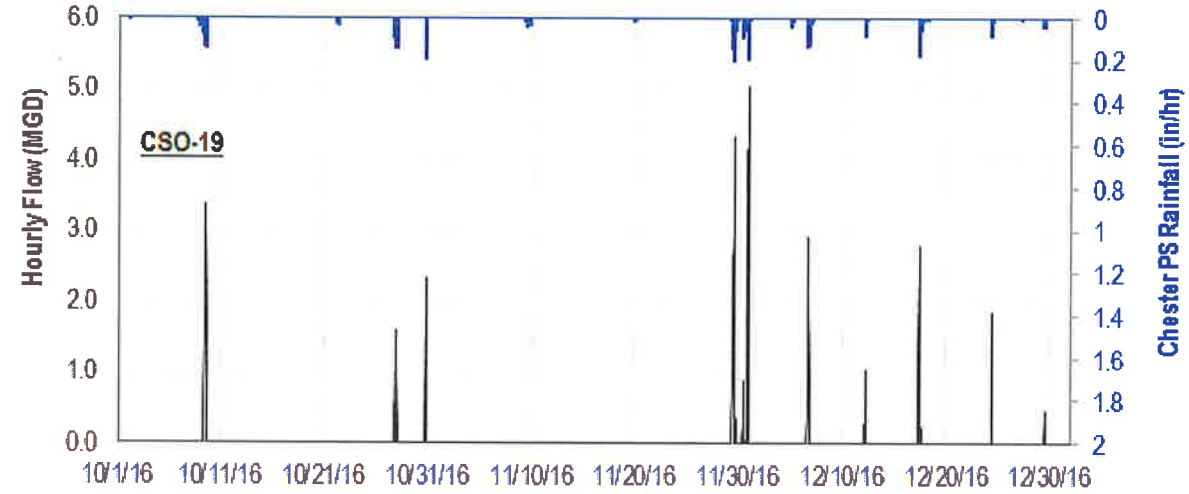


**Figure 36: Flow Monitoring Data, Eff-19**

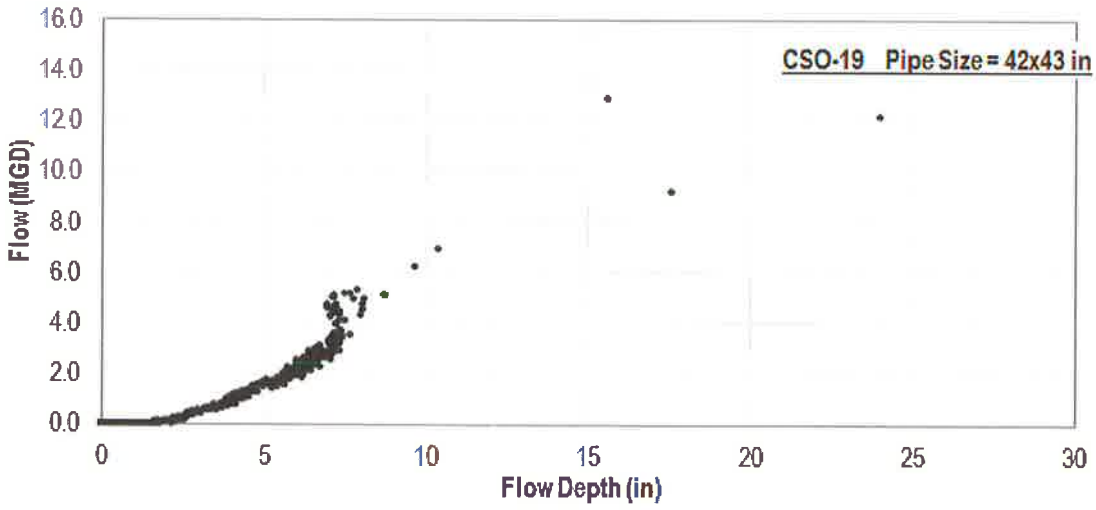


## Figure 37: Flow Monitoring Data, CSO-19

Hourly Hydrograph

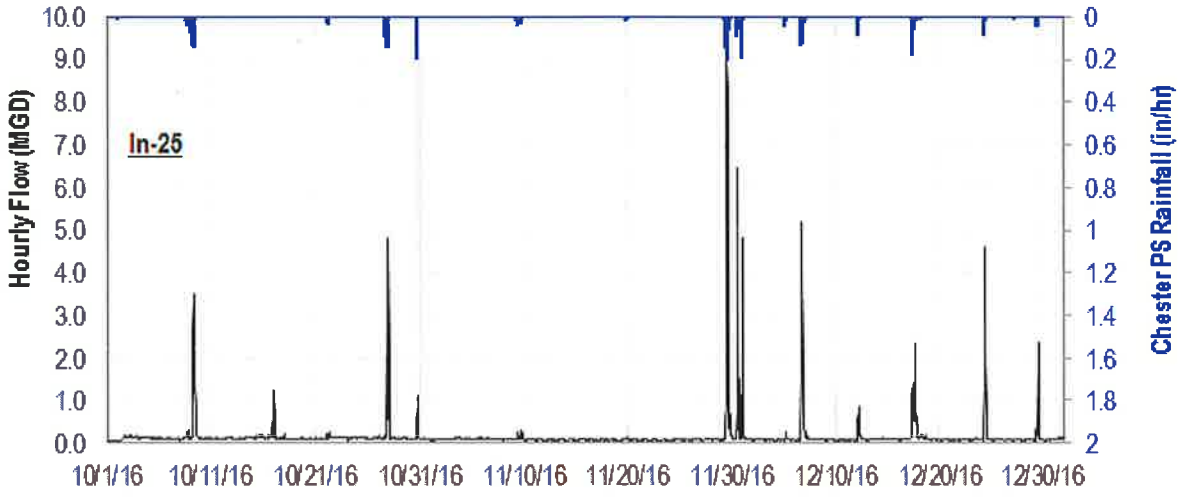



Scattergraph (Flow vs. Depth)



## Figure 38: Flow Monitoring Data, In-25

Hourly Hydrograph




Scattergraph (Flow vs. Depth)

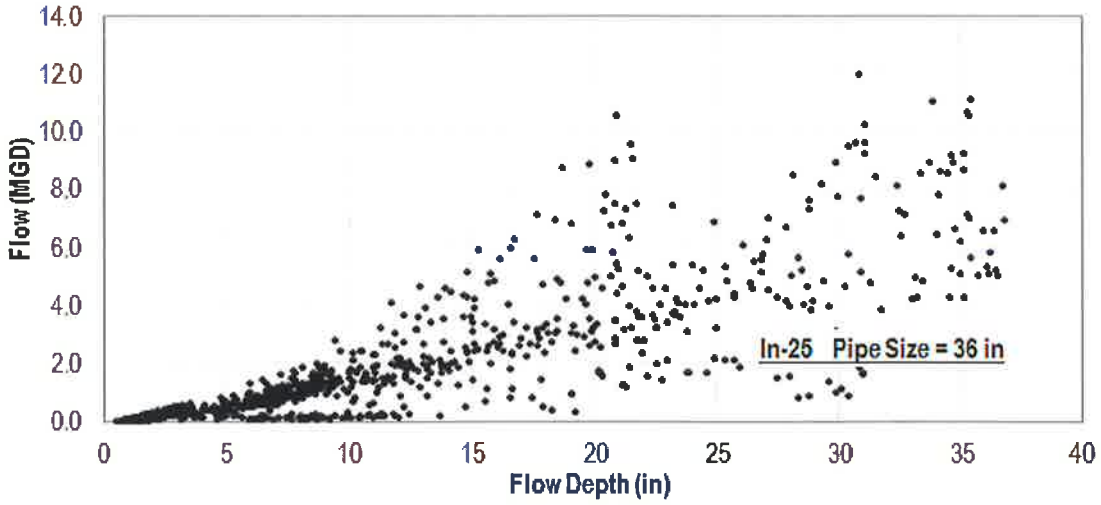
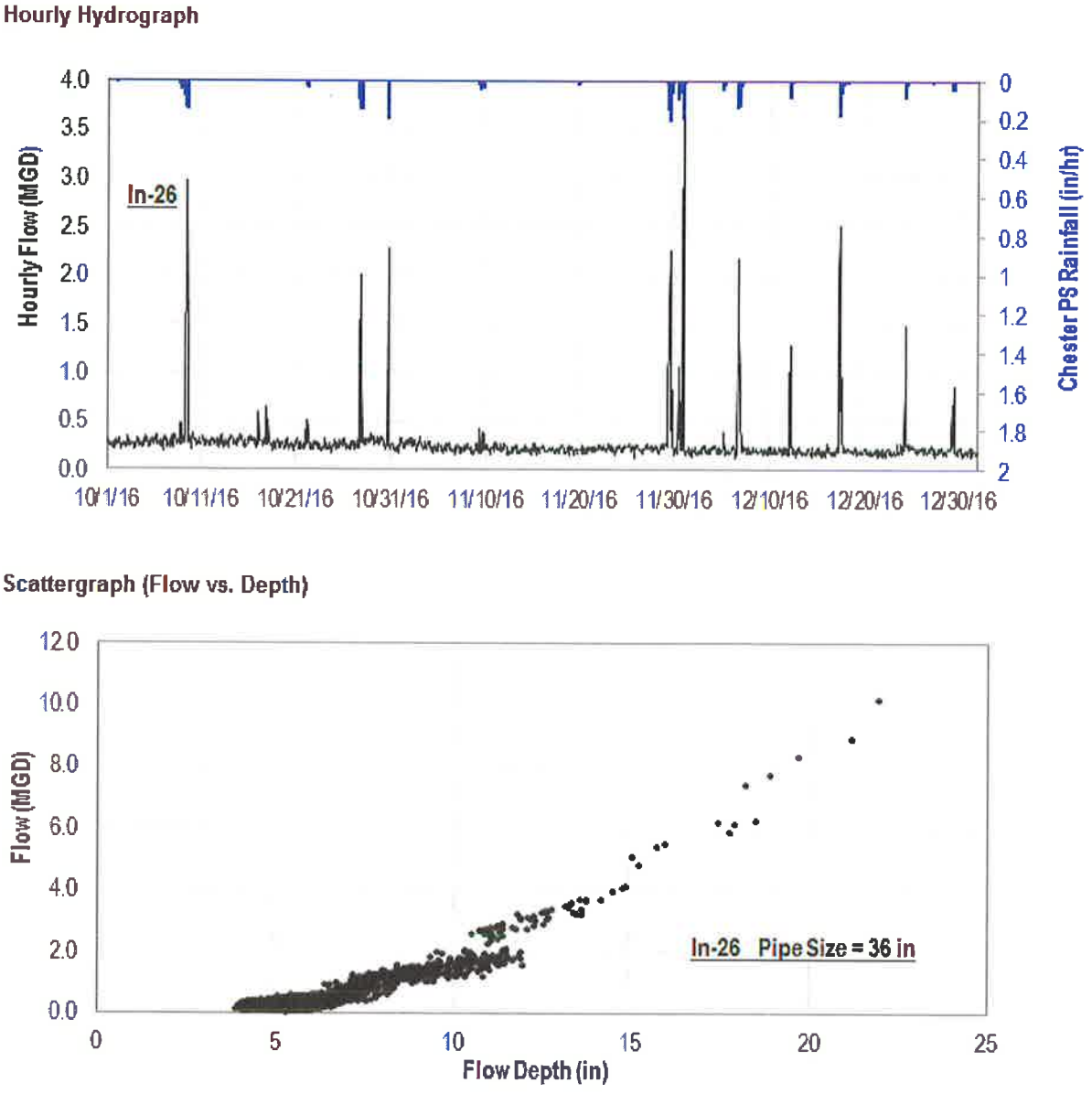
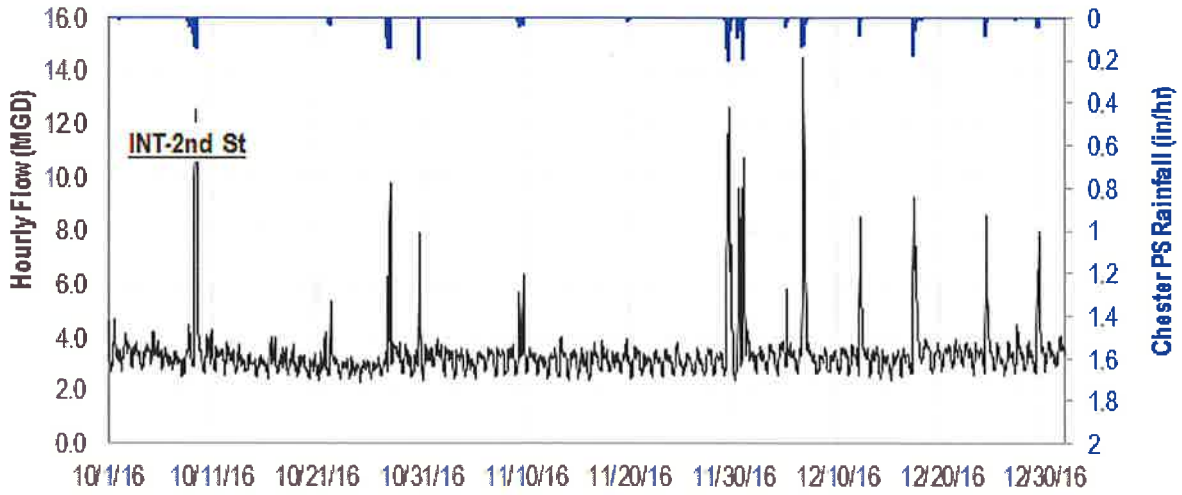


**Figure 39: Flow Monitoring Data, In-26**

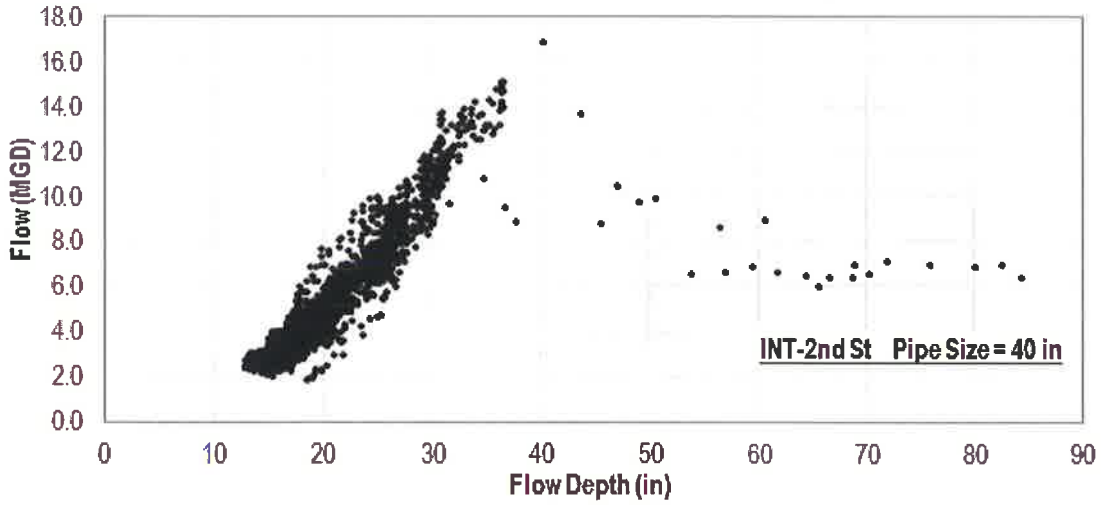


## Figure 40: Flow Monitoring Data, INT-2nd St

**Hourly Hydrograph**

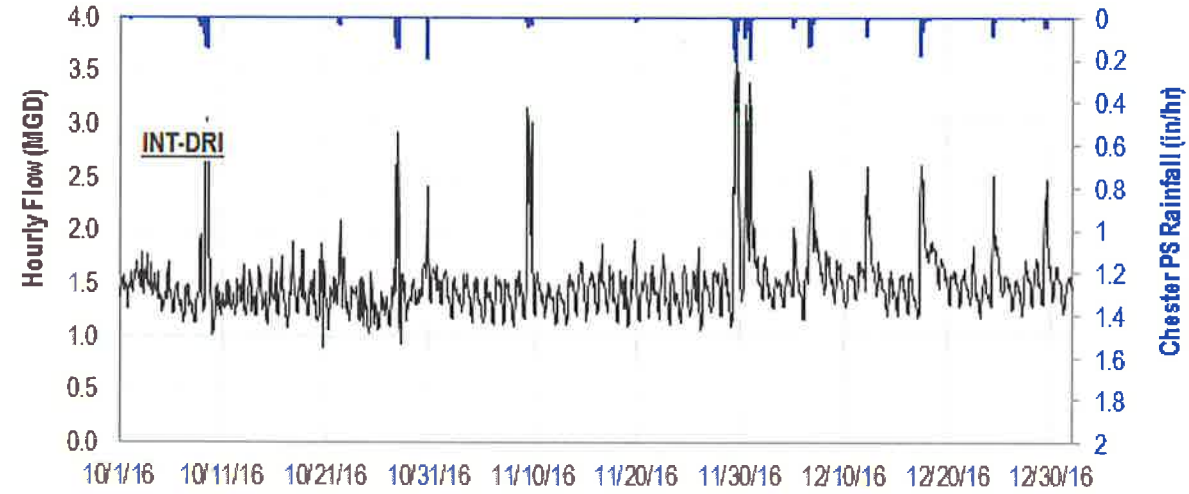



**Scattergraph (Flow vs. Depth)**



## Figure 41: Flow Monitoring Data, INT-DRI

Hourly Hydrograph




Scattergraph (Flow vs. Depth)

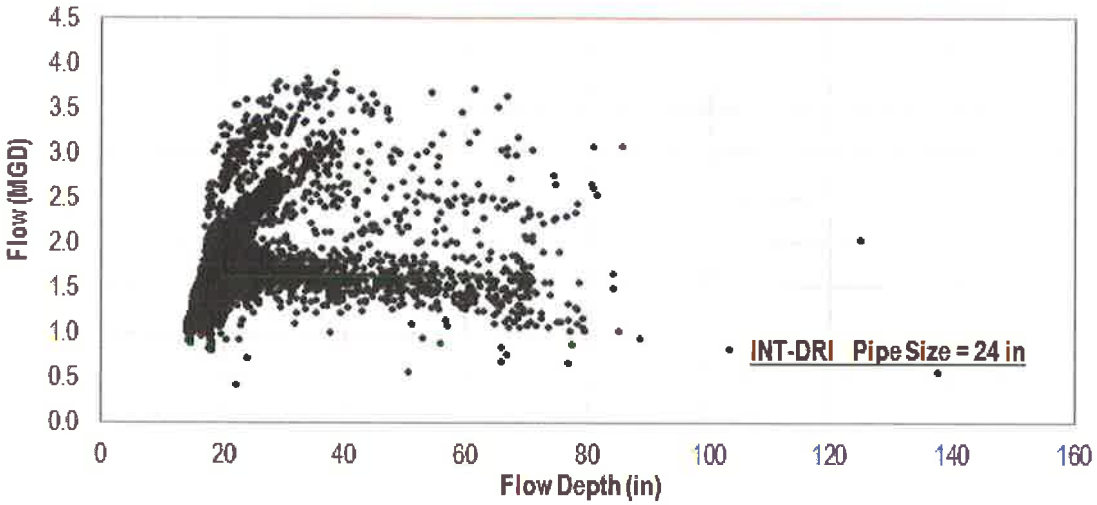


**Figure 42: Flow Monitoring Data, INT-Ridley 2**

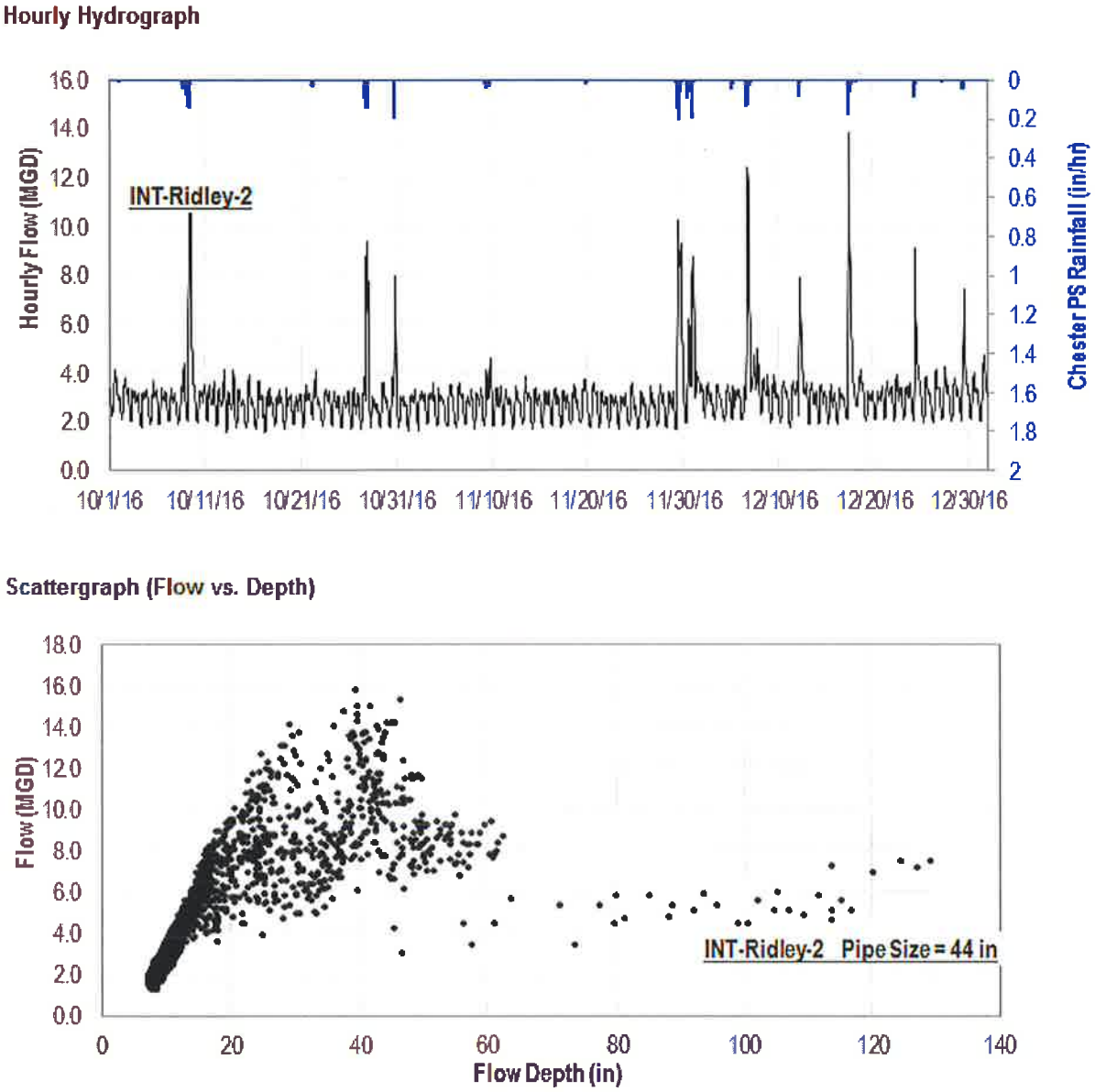
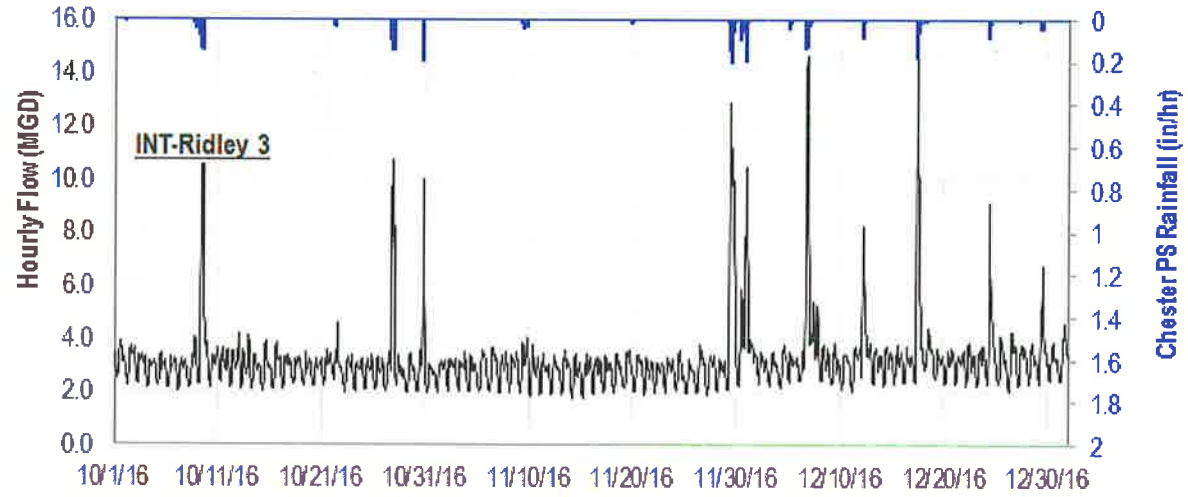
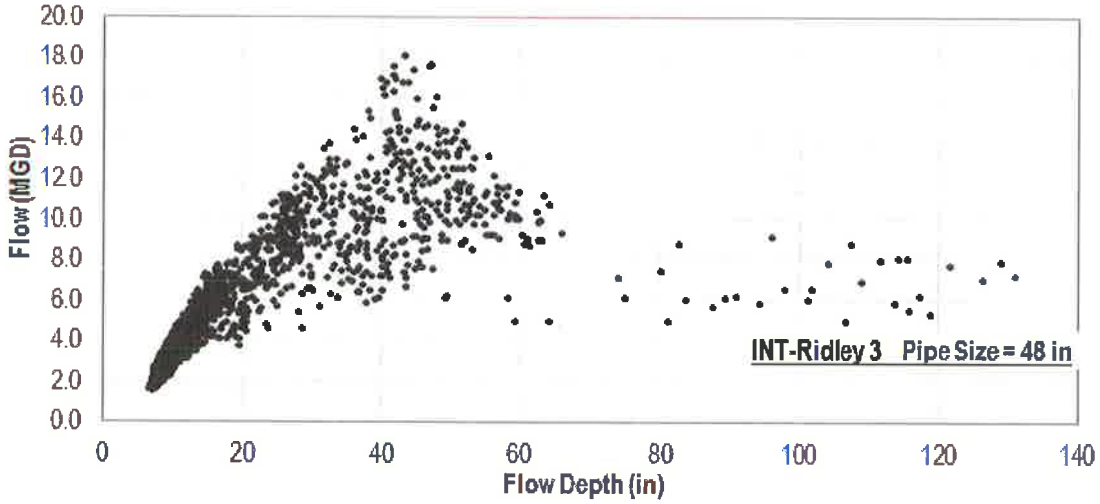


**Figure 43: Flow Monitoring Data, INT-Ridley 3**

**Hourly Hydrograph**

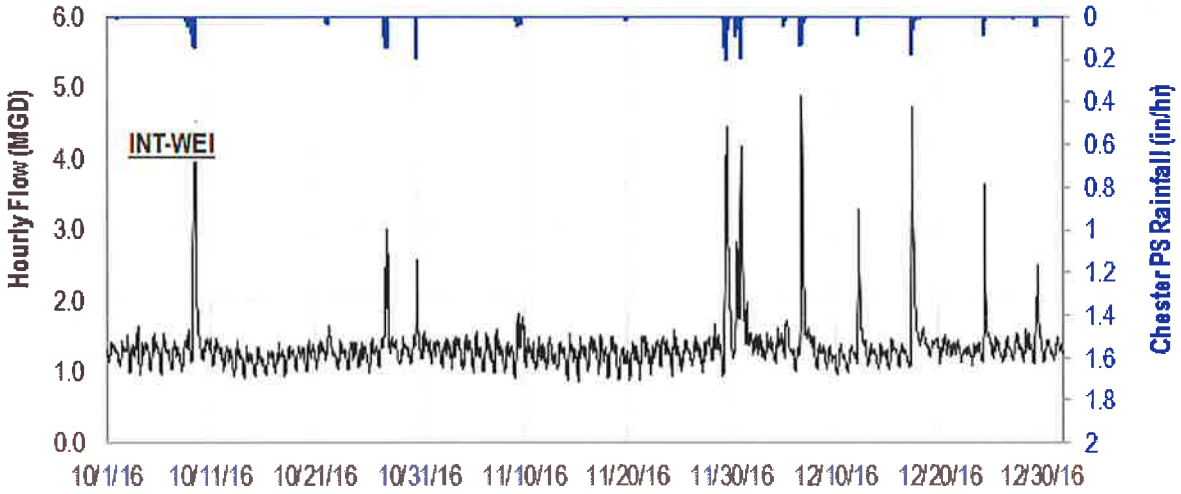



**Scattergraph (Flow vs. Depth)**

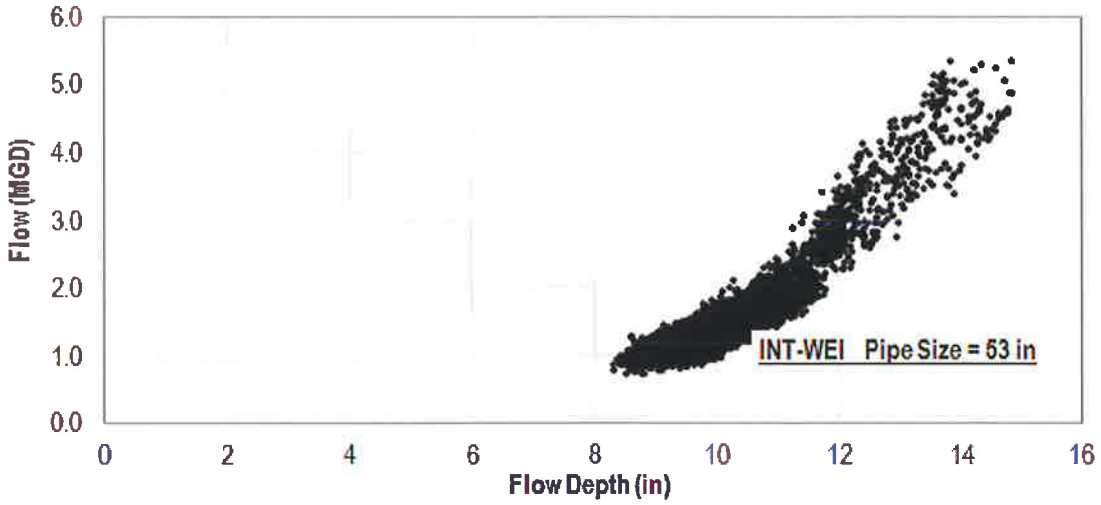


## Figure 44: Flow Monitoring Data, INT-WEI

**Hourly Hydrograph**

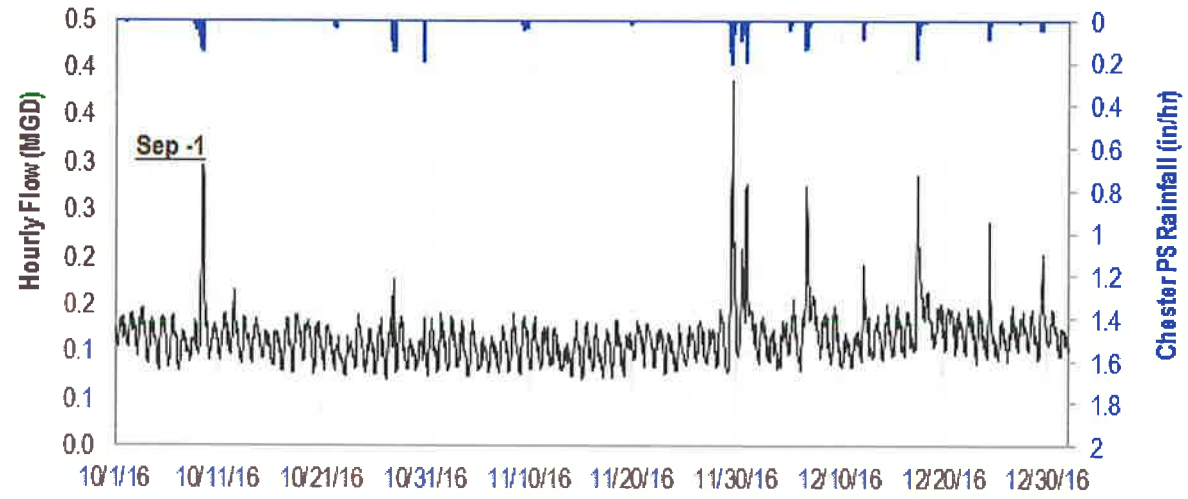



**Scattergraph (Flow vs. Depth)**

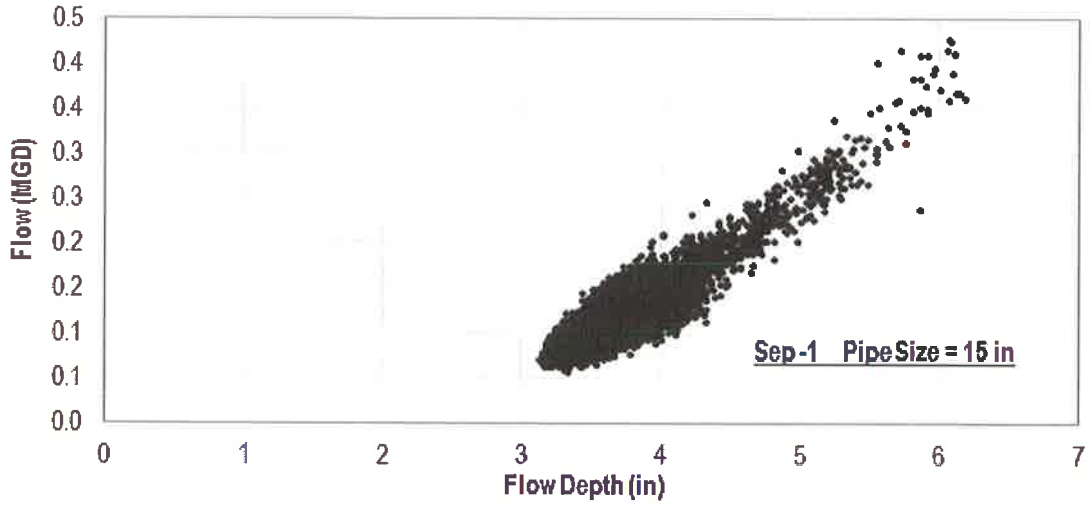


## Figure 45: Flow Monitoring Data, Sep-1

Hourly Hydrograph




Scattergraph (Flow vs. Depth)



## Figure 46: Flow Monitoring Data, Sep-2

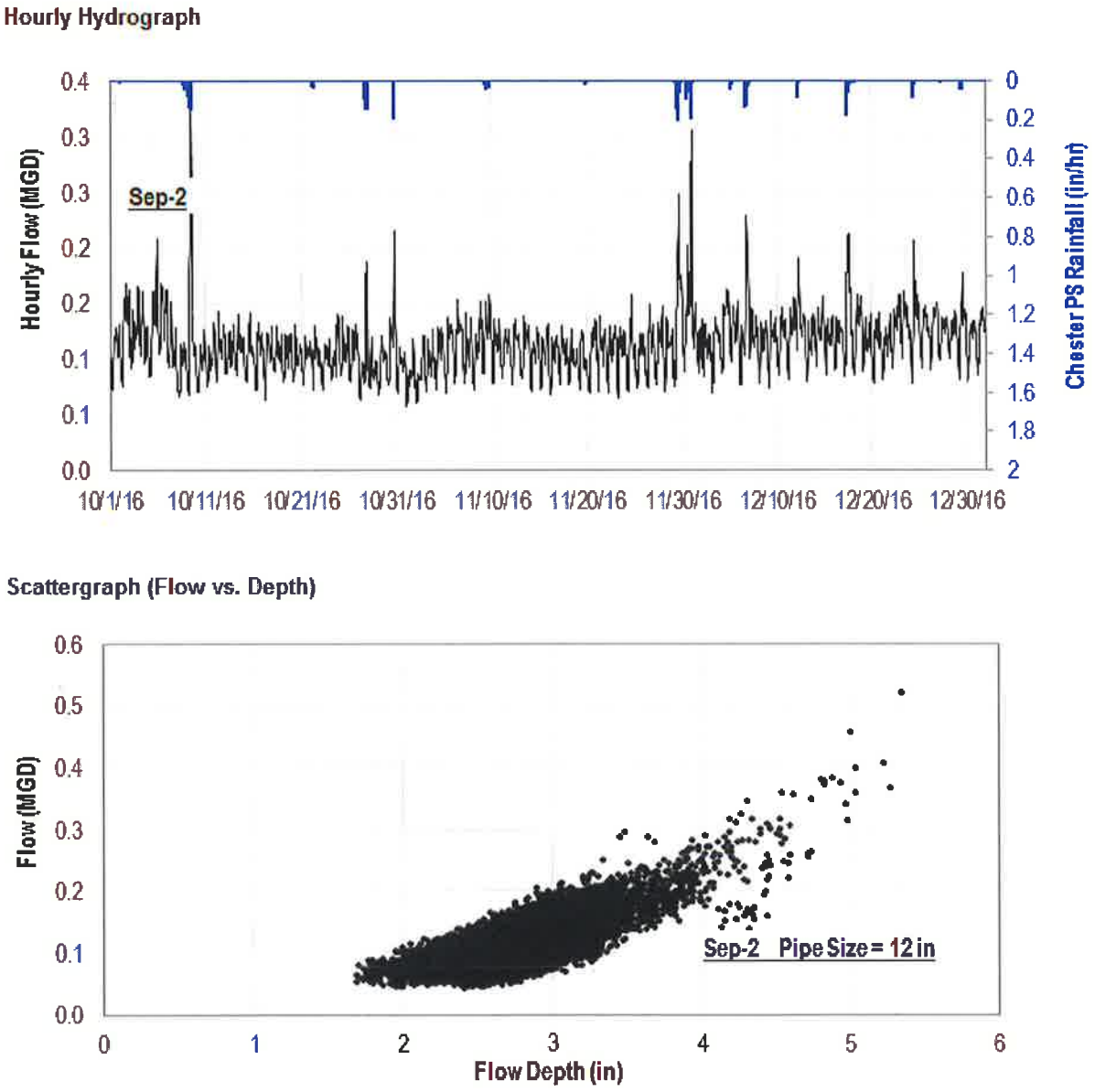
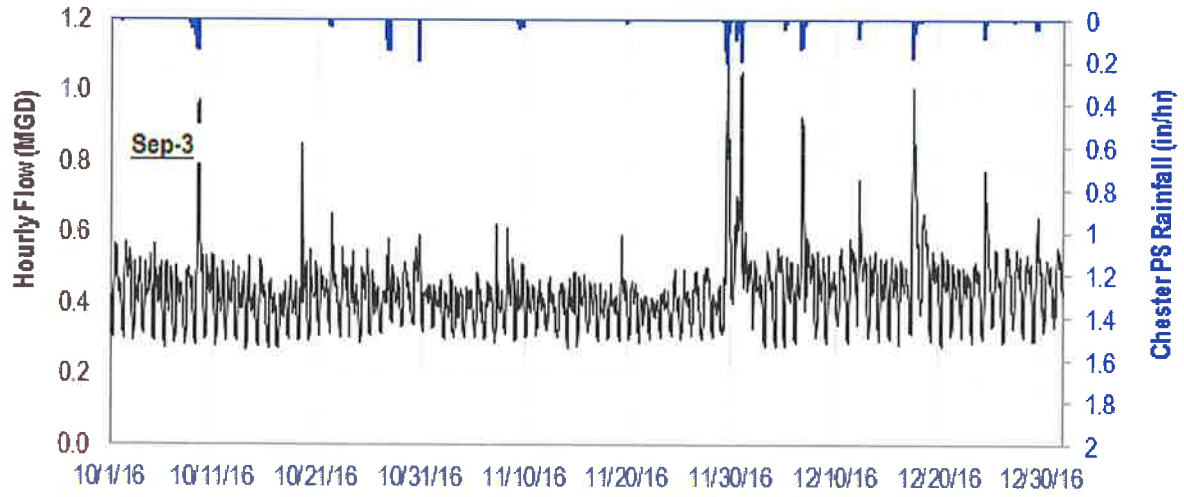
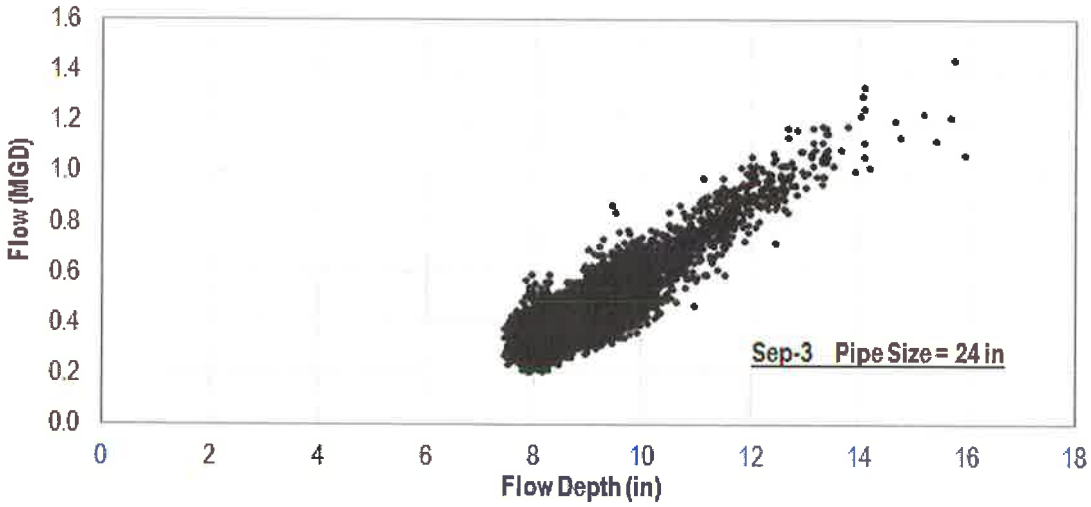


**Figure 47: Flow Monitoring Data, Sep-3**

Hourly Hydrograph

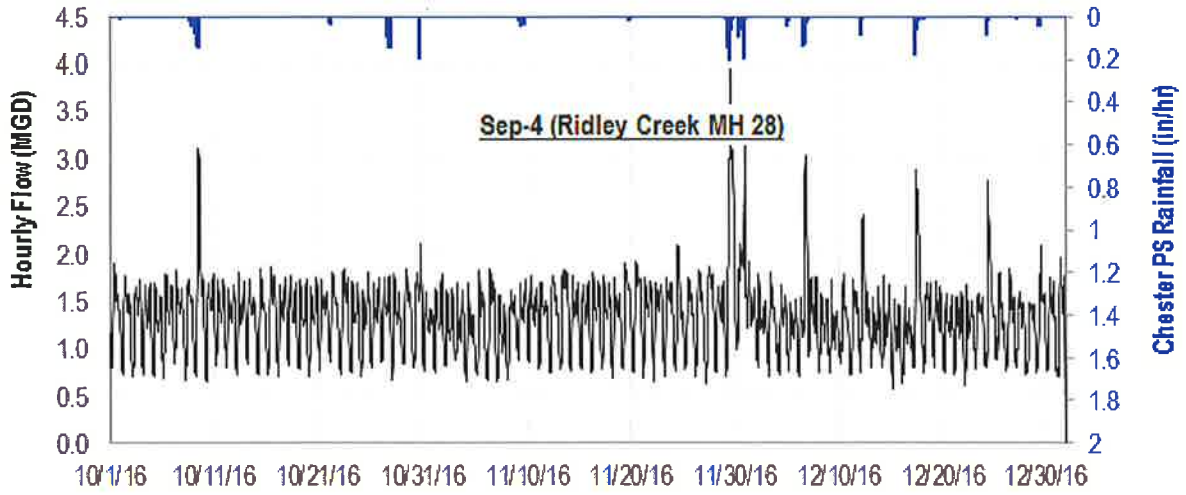



Scattergraph (Flow vs. Depth)

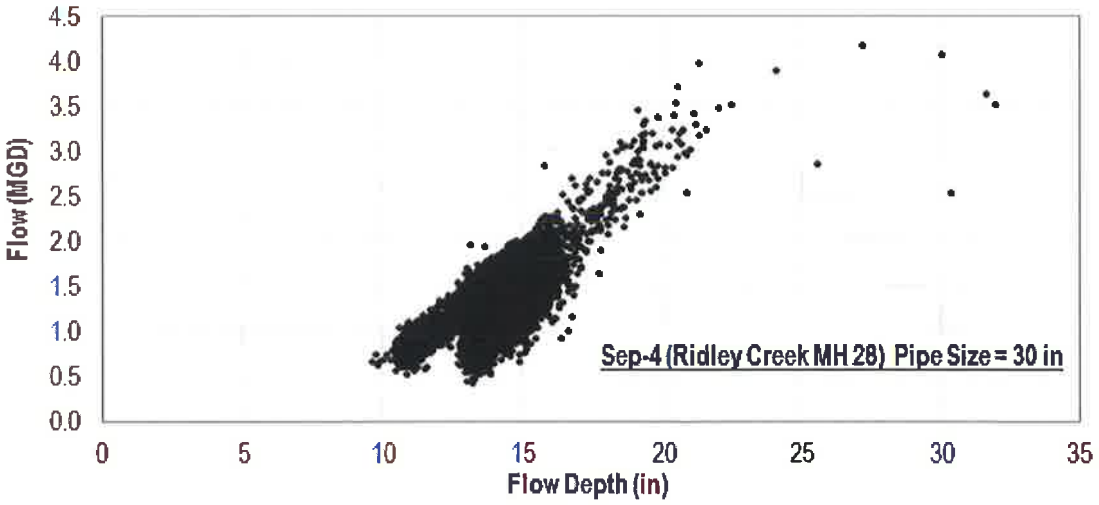


## Figure 48: Flow Monitoring Data, Sep-4

**Hourly Hydrograph**

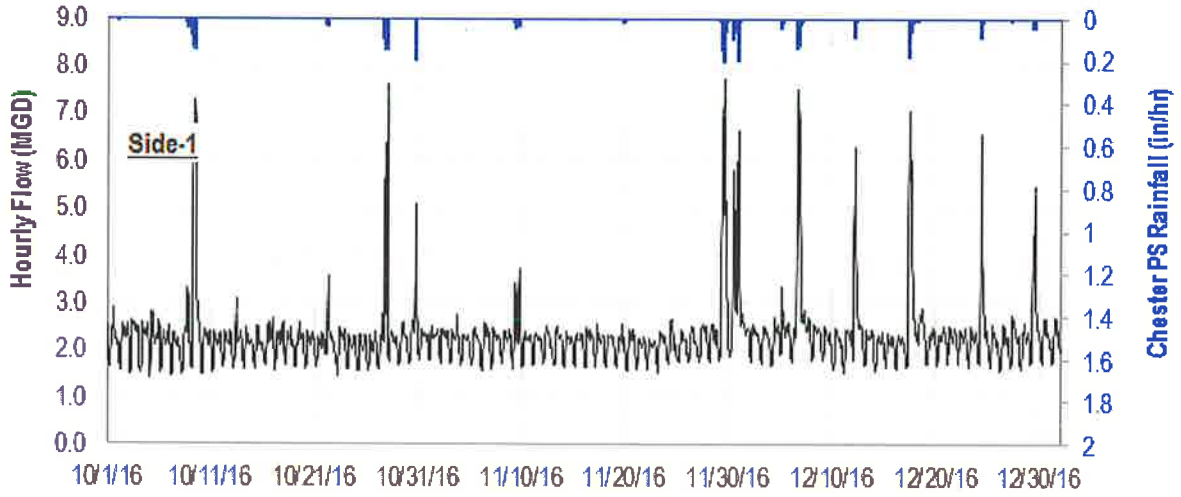



**Scattergraph (Flow vs. Depth)**



## Figure 49: Flow Monitoring Data, Side-1

**Hourly Hydrograph**




**Scattergraph (Flow vs. Depth)**

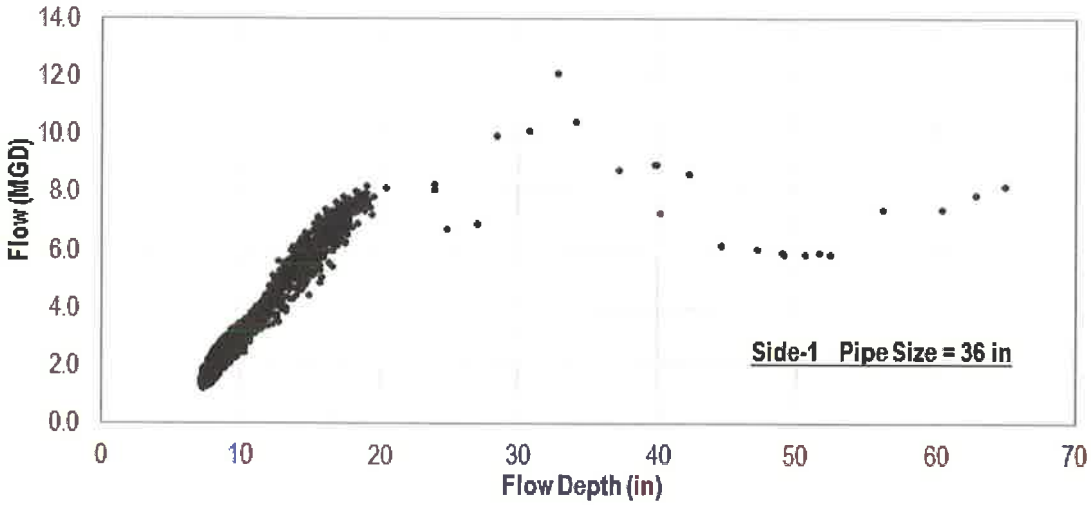
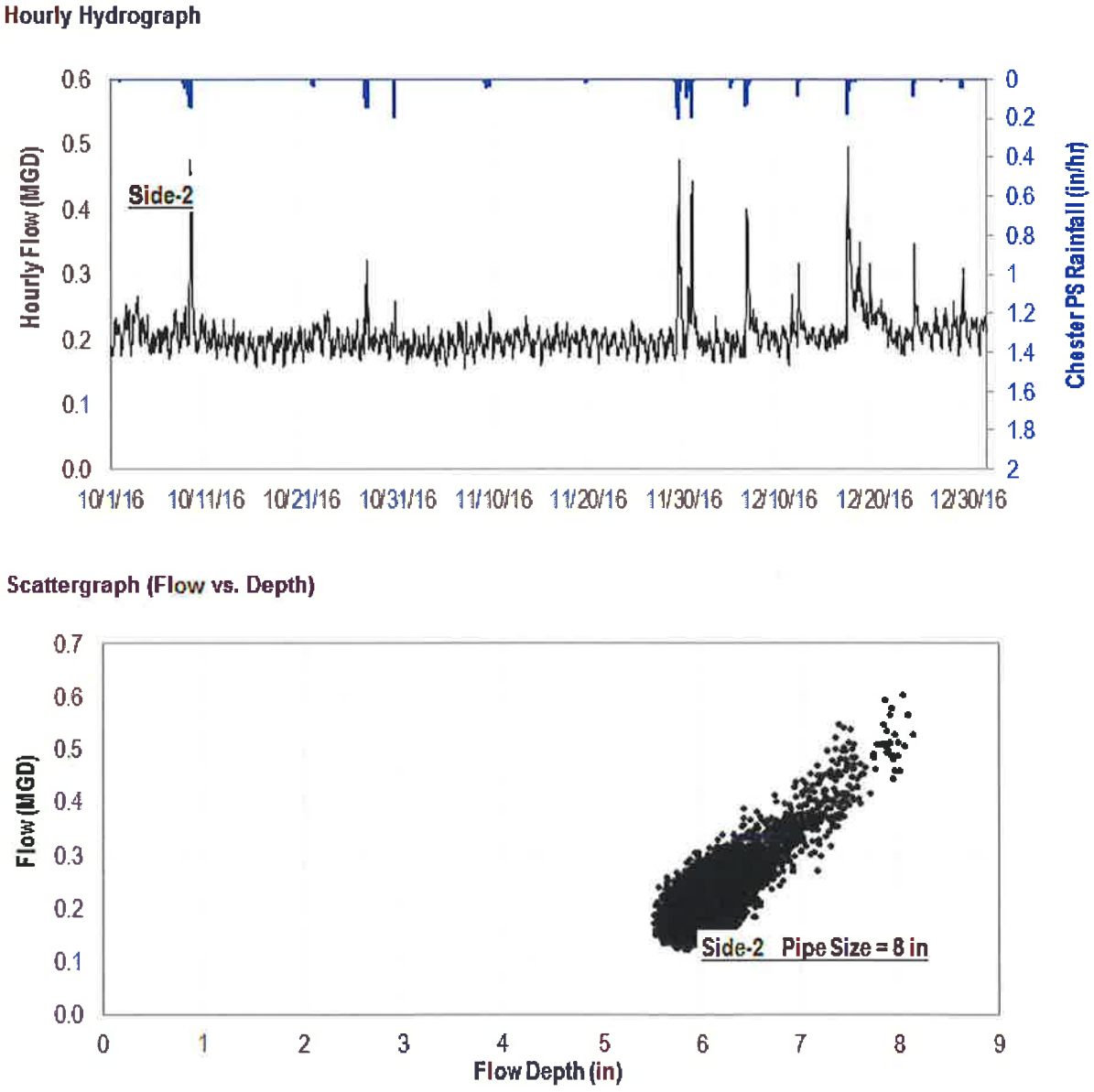


**Figure 50: Flow Monitoring Data, Side-2**



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